Study Related to Gap between the Irrigation Potential Created and Utilized

Sponsored by

Ministry of Water Resources
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Study Team

Professors: TV Ramanayya
V Nagadevara
Shyamal Roy

Indian Institute of Management Bangalore

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Acknowledgement

This study on issues related to gap between irrigation potential created and utilized is a very appropriate and challenging one at this point in time. The study team of Indian Institute of Management Bangalore is thankful to the Ministry of Water Resources, Government of India, for giving us the opportunity to associate with this project. We place on record the active support received from all the officials of the Ministry of Water Resources, specially the Secretary, Additional Secretary and Director (R&D) in the conduct of the study. The irrigation departments of different state governments have helped us in a number of ways in the study. Needless to say, we thank all the nodal officers for their support.. We have received excellent cooperation in organizing the PRA workshops by the staff of irrigation departments of Andhra Pradesh, Karnataka and Kerala. The study team also acknowledges the active participation in large numbers by the officers of the various departments associated with irrigation as well as water users association and in providing insights into the functioning of the operations at the field level. We also thank Mr. SR Purohit, Advisor, Technical, Water Resources Department, and Government of Karnataka, who had helped us as Advisor in this project.

Study Team

Professors TV Ramanayya
V Nagadevara
Shyamal Roy

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INTRODUCTION

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INTRODUCTION

1.0 Background

Agriculture, though just about 20% of GDP, is a key to sustained growth and macroeconomic stability of the Indian economy. First, sixty percent of India's population derives its livelihood from agriculture. That includes majority of poor in the country. Second, the sector is vital for food security. Third, with a weight of agricultural products at 23% of Wholesale Price Index (WPI), the performance of the sector, essentially, determines inflationary trends in the economy. Finally, a sustained growth in agriculture is seen as a prerequisite for attaining the overall growth of 9% per annum projected for the Eleventh Plan period. Both from the point of view of ensuring growth and social justice, thus, the agricultural sector in India will be a major driver.

Despite the importance of agriculture in the Indian economy, however, the rate of growth of agriculture has decelerated in the last decade to about 2% per annum as against 3.2% observed between 1980 and 1996-97. And, the eleventh plan is counting on a 4% growth of the sector in the plan period to achieve its overall growth target of 9%. Clearly, the crisis of stagnation in agriculture needs urgent attention.

The problems stem both from the demand and supply sides. Demand side constraints to growth arise from two sources. First, per capita food consumption seems to have stagnated in recent years and, second, agricultural prices being highly volatile, there have been periods when world prices turned weak to the detriment of domestic producers. These could have acted as disincentive to produce. The demand side bottlenecks have to be addressed by finding ways of augmenting export demand and by enabling higher domestic consumption by the poor through income enhancing measures.

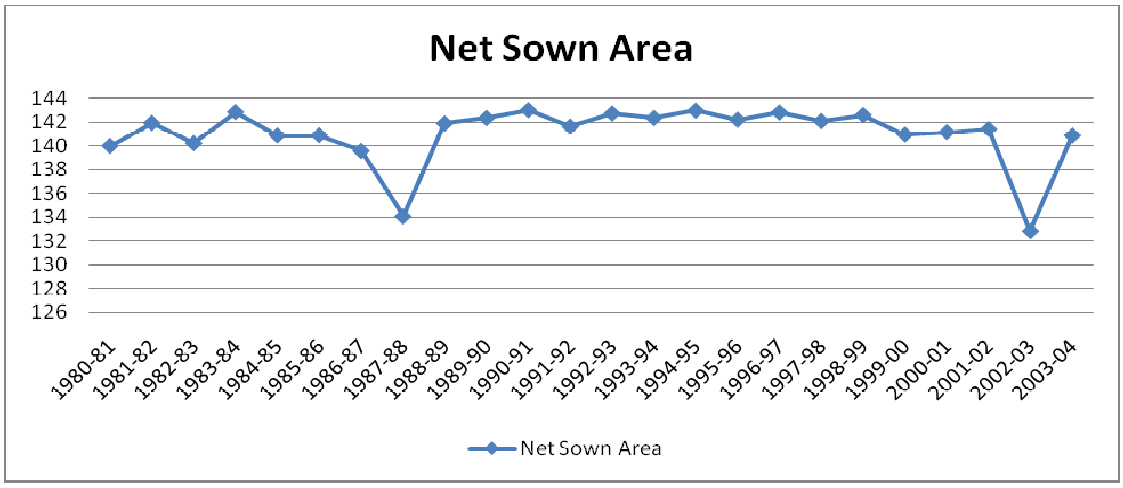
The supply side challenges, however, are more formidable. There has not been any green revolution since the last one, almost two decades back. None is in sight, either. Even if fresh initiatives are announced in this direction, technological change has a gestation period and, therefore, results will show only over a period of time. And yet, the eleventh plan target requires a growth rate (4% per annum), which has not been attained in a long time. Needless to say, the gains in production will have to come through better exploitation of existing technology. And, the only way this can be facilitated is by reducing the gap between the potential offered by the existing technology and its actual realization.

Against the above background, we look at the crucial role of irrigation as a major driver of growth and equity in Indian agriculture.

1.1 The Crucial Role of Irrigation

Irrigation is perhaps the most important input in the agriculture production function. It plays an important complementary role in the production process. The other key inputs, namely, seed and fertilizer cease to realize their full benefit unless combined with irrigation. Also, in an economy where the supply of land is highly inelastic and the net sown area growth has leveled off (Figure 1.1), the future growth of agriculture is heavily dependent on intensive cultivation of the existing land. Irrigation greatly facilitates this by enabling farmers to grow multiple crops on the same plot of land across different agricultural seasons.

Figure 1.1 : Net sown Area in million hectares, 1980-81 to 2003-04



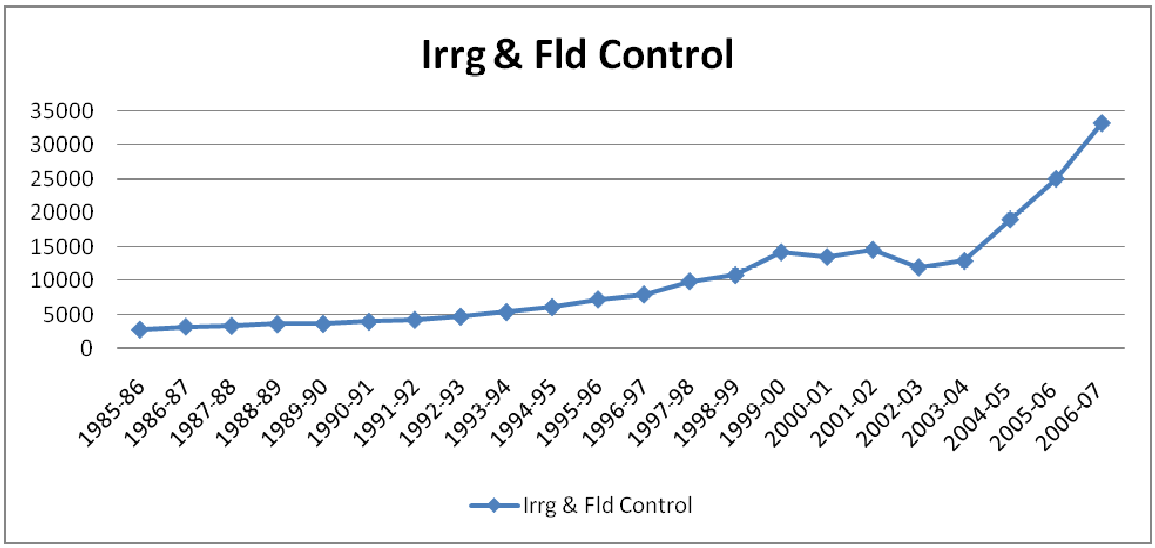
Source: www.rbi.org.in

1.2 Public Investment in Irrigation

The government has, of course, been alive to this reality. Government investment in irrigation and flood control has been rising over the years and has received a further boost in the recent years (Figure 1.2). Specifically, government expenditure on irrigation increased by 96 percent between Seventh and Eighth Plan period and further by 87 percent between Eighth and Ninth Plan period. Major and Medium irrigation increased by 95 and 98 percentage points during these periods and Minor irrigation by 98 and 49 percentage points during the same period (Table 1.1). Besides, the Government has been spending between Rs. 2000 and 3000 crores every year in the last few years towards

Accelerated Irrigation Benefit Programme (AIBP) for speedier completion of irrigation schemes.

Figure 1.2: Expenditure on Irrigation and Flood Control in Current Prices (Rs. Crores)



Source: www.rbi.org.in

Table 1.1: Plan-wise Government Expenditure on Irrigation in Current Prices (Rs. Crores)

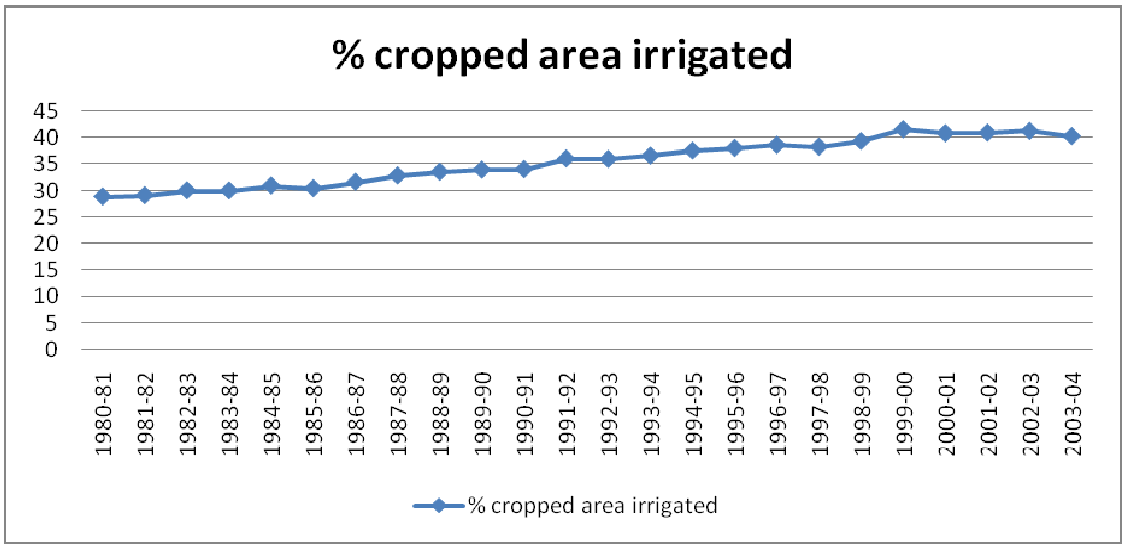
Sector	Seventh Plan	Eighth Plan	Ninth Plan
Major & Medium	11107.29	21668.95	42959.34
Minor	3118.35	6282.34	9362.03
Total	14225.64	27951.29	52321.37

Source: www.indiaagristat.com

These efforts have resulted in creation of additional irrigation potential of 5.17 million hectares (2.21 major/medium and 2.96 minor) during Eighth Plan period; 7.60 million hectares (4.10 major/medium and 3.59 minor) during Ninth Plan and, another 8.82 million hectares (5.30 major/medium and 3.52 minor) during the Tenth Plan period. The Eleventh Plan forecasts a further addition to irrigation potential of 11 million hectares, to be contributed equally by major/medium and minor irrigation.

At the end of 2003-04 (Figure 1.3), 40 % of the cropped area was irrigated compared to 28% in 1980-81.

Figure 1.3: Percentage of Cropped Area Irrigated, 1980-81 to 2003-04



Source: www.rbi.org.in

Increased availability of irrigation has also facilitated more multiple cropping. Irrigation has made possible cultivation of crops even in the dry season. This is reflected in rising cropping intensity. Cropping intensity has gradually increased from 123% in 1980-81 to 133% in 2003-04 (Figure 1.4).

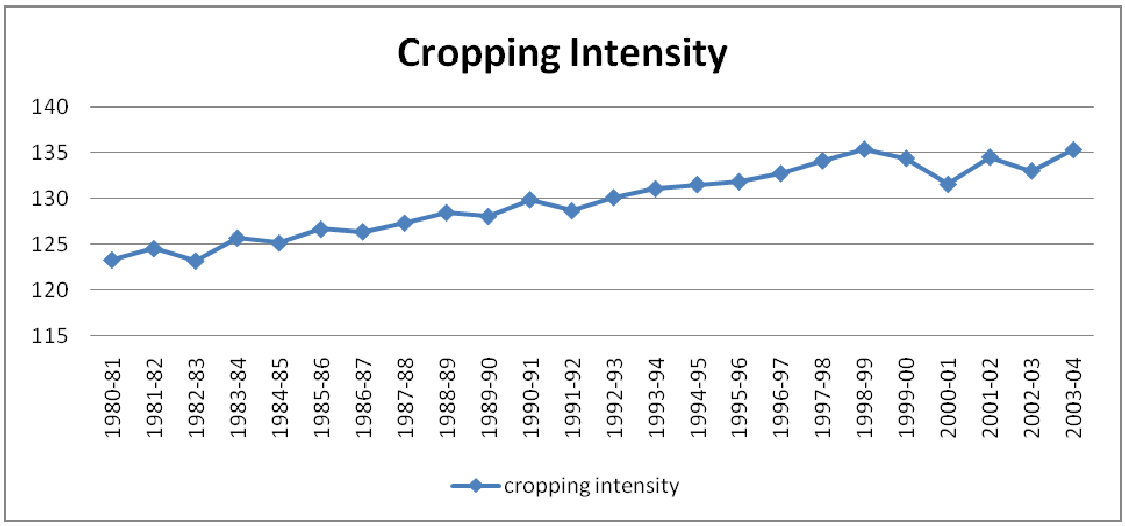
Also, there is evidence to show that the increase in gross value of agricultural produce in India has resulted primarily from irrigated areas (Table 1.2). Irrigation has helped in realizing higher productivity from seeds and fertilizers. It has also, as mentioned earlier, opened up opportunity for multiple cropping.

1.3 The Problem

Both in respect of progress of cropped area under irrigation and cropping intensity, however, a slowdown is discernible in the more recent period. Particularly, the increase in irrigated area does not appear to be commensurate with the very impressive rise in expenditure on irrigation. Reasons could be many: long gestation period of major irrigation projects; an excessive emphasis on major as against medium and minor projects; cost escalation and, above all, perhaps too much to supply rather than demand side of water use.

Clearly, if the projected growth of 4% in agriculture has to be realized, primarily by improving the efficiency of existing technology, technical and allocative efficiency of irrigation sector has to be addressed.

Figure 1.4: Cropping Intensity in India, 1980-81 to 2003-04



Source: www.rbi.org.in

Table 1.2: Contribution of Irrigated and Un-irrigated Crops to increase in Value of Crop Production, 1971-73 to 1991-93

	1971 – 73 GCA Mha	GVP (Rs. Crs)	1991 – 93 GCA Mha	GVP (Rs. Crs)	Increased output from area change (Rs. Crs)	yield change (Rs. Crs)	Total (Rs. Crs)
Irrigated	37.1	38200	64.1	96500	27800	30800	58300
Rain fed	119.8	46300	108.4	66200	- 4400	24300	19900
Total	156.9	84500	172.5	162800	234	54900	78200

Source: A Vaidyanathan, "Water Policy in India" Centre for Public Policy, Indian Institute of Management Bangalore

The fundamental problem in the irrigation sector is that attempts to speed up utilization of irrigation potential and improve the efficiency of water use– partly through special programmes (like command area development and the national water management project) and partly through institutional changes (such as involvement of users association in maintenance and water regulation at the tertiary level and integration of water resource planning) have met with only limited success.

Table 1.3 brings out the gap between irrigation potential created in million hectares and its actual utilization over the plan period. Not only a gap exists between potential created and its utilization but the gap seems to be widening over successive plans. This is true of both major/medium and minor but more pronounced in the former.

Table 1.3: Irrigation Potential Created and Utilization over the Plan Periods

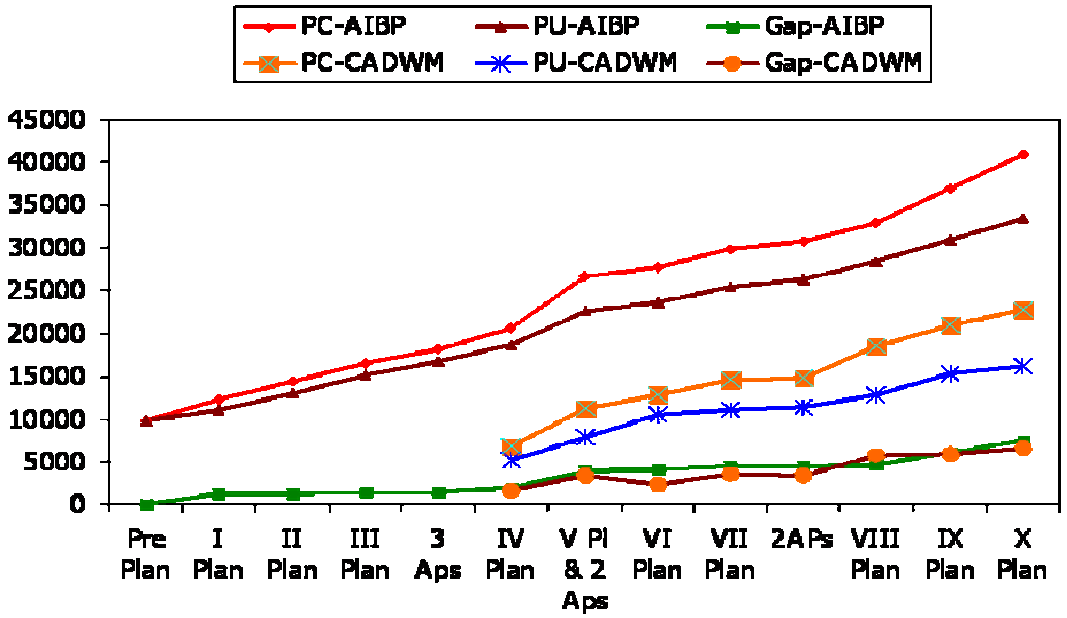
Cumulative Potential Created (ml. ha)	**1991/92**	**Eighth Plan**	**Ninth Plan**	**Tenth Plan**
a. Major/ Medium	30.7	33.0	37.1	42.4
b. Minor	50.4	53.3	56.9	60.4
c. Total	81.1	86.3	94.0	102.8
Cumulative Potential Utilized (ml. ha)				
a. Major/ Medium	26.3	28.4	31.0	34.4
b. Minor	46.5	48.8	50.0	52.8
c. Total	72.9	77.2	81.0	87.2
Percent Utilization				
a. Major/ Medium	85.6	86.3	83.7	81.3
b. Minor	92.4	91.5	87.9	87.4
c. Total	89.8	89.5	86.2	84.9

Source: Economic Survey, 2007-08

The other problem is that while all data/reports point towards the existence of a gap between irrigation potential created and utilized, the extent of the gap varies depending on whether the data is provided by the irrigation department, revenue department, bureau of economics and statistics or the department of agriculture (Figure 1.4).

As a first step towards reducing the gap and increasing the efficiency of irrigation system, therefore, it is important to reconcile the differences that exist in the measurement of water utilized, by different agencies and arrive at a realistic size of the gap. Only then the Government can initiate steps and allocate resources to narrow the gap.

Figure 4: Gap in PC and PU as achieved under AIBP under Plan Periods



The Ministry of Water Resources, Government of India, accordingly, has asked the Indian Institute of Management Bangalore to conduct a study to look into different aspects of the gap between irrigation potential created and utilized in 10 states/union territories, namely, Kerala, Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh, Goa, Pondicherry, Daman and Diu, Andaman & Nicobar Island and Lakshadweep

1.4 Objectives of the Study

The broad objective of the study is to examine various issues related to irrigation potential creation, its utilization, gross and net irrigated areas, including definition, reporting practices and consistencies in estimates.

More specifically, the objectives are:

1. To identify the gap between irrigation potential created and utilized from the point of view of potential that a) has never been utilized, b) has not been utilized regularly and c) has gone into disuse due to various reasons
2. To find reasons for the gap, both from the supply and demand sides
3. To suggest measures for minimizing the gap

4. To reconcile differences in the estimates of gaps as reported by different agencies and,

5. To suggest a procedure for collection of data that can be applied uniformly throughout the country for the estimation of the gap

1.5 Methodology

A brief description of the methodology is given below:

2. The sample will consist of 2 major irrigation projects in the larger states and 1 major irrigation project in smaller states; 4 medium irrigation projects, representative of different regions of the state, in each state; and a cluster of minor irrigation projects in each state.
3. Data on each project selected in the sample will be collected from secondary sources with the help of nodal officers, through a structured questionnaire
4. This will be supplemented by primary data collection through random sampling of farmers in the project areas

A more detailed methodology is presented in Chapter 2.

1.6 Expected Outcome

1. Identify reasons for gap
2. Address Definitional Inconsistencies
3. Develop Global Definitions
4. Reconcile data differences across sources
5. Estimate the actual gap
6. Identify Strategies for bridging the gap

1.7 Organization of the Report

The report is organized into eleven chapters. Chapter-1 presents the background to the study. Chapter-2 outlines the methodology adopted in the study. Chapter-3 provides information on data collection and field surveys. Chapter 4 to 8 provides information for each of the five major states namely, Andhra Pradesh, Karnataka, Tamilnadu, Kerala and Maharastra respectively. Chapter-9 reviews the information regarding other smaller regions of the study area. Chapter-10 details the findings of participatory Rapid Appraisal workshops conducted at Hyderabad in the state of Andhra Pradesh, Bangalore in Karnataka State and Thrissur in Kerala State and theoretical scenario for the gap between potential created and utilized as well as the definitions of the terms used. The summary of the report is presented in Chapter 11.

CHAPTER 2

METHODOLOGY

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METHODOLOGY

2.0 Methodology as Originally Envisaged:

Originally, a three step methodology was envisaged: a) secondary data collection from the Irrigation Departments of the states covered under the study b) primary data collection from the individual farmers through a structured and pre-tested questionnaire and, c) PRAs conducted with the officers of departments involved with irrigated agriculture as well as elected representatives. The idea was to integrate the responses received from these three sources and arrive at a coherent view on various issues.

Step 1:

This involved collection of data from the irrigation departments of the states/UTs covered under the study. These are: Andhra Pradesh, Tamilnadu, Kerala, Maharashtra, Karnataka, Goa, Pondicherry, Diu and Daman, Andaman and Nicobar Islands and Laksha Deep Islands. The original plan was to collect data for five years from 2002-03 to 2006-07 on the following items:

- Area irrigated under each major, medium and minor irrigation project;
    - Kharif
    - Rabi and
    - Summer
- Quantity of water released from each project at the Main canal, minors, and distributories in each of the 3 crop seasons
- Amount of rainfall both in the command area and the catchment area
- Irrigation potential created (as estimated at the time of project completion) as well as the quantity of water estimated to be impounded/supplied as per the original project document.
- Cropping pattern as envisaged at the time of project formulation (as per the project report)

The above data was considered necessary to a) estimate the gap between irrigation potential created and potential utilized on a yearly basis, for different seasons, by each major, minor and distributor and, at head reach, mid reach or tail reach locations, b) to

relate the gap not only with respect to acreage but also with respect to water impounded and released over the past 5 years and, c) to correlate with the rainfall in the command area as well as in the catchment area and the cropping pattern.

To facilitate data collection process, special workshops for the officers of the Irrigation Department in each of major states was planned. The objectives were to a) apprise the officers about the need for and scope of the study and to brief them on various aspects of formats for data collection; b) to understand the nature and availability of the data vis-à-vis the requirements of the study c) to develop links with key officials who would help in the data collection efforts and d) to develop, through these interactions, a deeper understanding of the irrigation projects in the concerned states. While conducting the workshops in the major states, officers of the neighboring minor states were also invited to these workshops.

Step 2:

In Step 2, a sample of major, medium and minor projects was to be selected for in-depth study of the irrigated agriculture and the effectiveness of the organizational structure that are put in place for the management of irrigation water. The original plan was to select the sample of these projects based on the data collected in Step 1. Approximately, 500 farmers were to be selected in each major state (Andhra Pradesh, Tamilnadu, Kerala, Maharashtra and Karnataka) and 300 farmers in each of the 5 minor states (Goa, Pondicherry, Diu and Daman, Andaman and Nicobar Islands and Laksha Deep Islands). The sample was to be drawn up in a manner that farmers located in the head reach, mid reach and tail reach of the main canals and distributaries, each, was properly represented.

Data was collected from the sample farmers through a structured and pre-tested questionnaire. The questionnaire was designed to elicit information on a wide range of items such as size of land holding size (including irrigated and un-irrigated land), season wise cropping pattern for the past 5 years, crop yields, income and expenditure data, role

of farmers' associations like water users' associations and the level and nature of their interactions with the officials of the irrigation department.

Step 2 data analysis was expected to throw light on relationship of yields of crops to adequacy of water; deviation between proposed cropping patterns at the time of project design and actual; size of the gap between potential created and utilized as measured from extent of irrigated area left un-irrigated; and, finally, information on farmers' expectations from the officials of different departments and organizations connected to irrigated agriculture

Step 3:

Step 3 involved conduct of PRAs for the officers of all the state departments connected with irrigated agriculture. These are: Irrigation Department, Agriculture Department, Revenue Department as well as directorate of Economics and Statistics. Also, representatives from various organizations such Water Users' Associations were included in the PRAs. The objective of the PRAs was to elicit opinion of the officers on the reasons for the gap in irrigation potential created and potential utilized, the methodology adopted by different departments in measuring the potential, the role of various organizations and the elected representatives etc. The original plan was to conduct these PRAs in each of the 5 major states.

The combination of the three steps, outlined above, was thus expected to provide an integrated view of the gap between irrigation potential created and utilized, the possible reasons thereof and, likely remedies. In the entire methodology, Step 1 was the most crucial step as the information, thus gathered, was a pre-requisite for data collection in steps 2 and 3.

Methodology Actually Followed

Step 1:

The study team was able to conduct workshops in each of the major states, though there were delays in organizing those because of inability of States to appoint liaison officers

on time. Even when appointed, they were changed frequently. Nevertheless, the workshops were well attended and the senior officers (including Principle Secretaries) were briefed about the project and, the formats for data collection were explained. The officers, by and large, agreed to provide the data as per the format provided; in some cases, some minor modifications were suggested in the format to suit the availability of data.

Ironically, not a single state department provided complete data as promised. And this, despite several reminders and visits from, not only the study team but also CWC. Therefore, the study team was left with no alternative but to go ahead with selection of sample projects without the complete data. The only data that was made available to the study team was the quantity of water released in the selected canals and distributaries. No information on the potential created under the selected distributaries or the actual area irrigated was made available. The choice and representativeness of sample projects were finally decided on the basis of several iterations with the officials of the irrigation department.

Step 2:

While obtaining secondary data was a problem, in the collection of primary data, the study team received full cooperation from the officials of irrigation department.

A structured questionnaire was prepared and pre-tested. The pre-tested questionnaire was used to obtain the required data from the sample farmers.

In the absence of any reasonable data from the states under Step 1, the conclusions drawn in the study are primarily based on the analysis of data obtained from the sample farmers.

Step 3:

The study team was able to conduct 3 PRAs, one each in Andhra Pradesh, Karnataka and Kerala. The PRAs have provided useful insights into the perceptions of the officials and

the elected representatives. The analysis of the data collected in Step 1 is correlated with the findings of the PRAs for drawing final conclusions.

Even now, the study team is willing to invest its time in analyzing the data as proposed in Step 1, provided the Ministry of Water Resources, Government of India can persuade the concerned state departments to supply the required data as per the formats given by the study team within the next one month. This is purely in the interest of the study.

CHAPTER 3

DATA COLLECTION AND FIELD SURVEYS

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DATA COLLECTION AND FIELD SURVEYS

3.0 General

As briefly mentioned in Chapter 2, the project activities were broadly divided into the following steps:

a) Secondary data and analysis leading to selection of sample projects for primary data collection.

b) Primary field data from farmers.

c) Data on selected main canals/ distributaries from field offices

d) Data and analysis through PRAs.

These steps are detailed below:

3.1 Secondary Data Collection

The original plan was to obtain data for the all the major/medium projects in the study region. The schedules developed for this purpose are provided in Annexure-1. These schedules included information on gaps at gross project level. The information in schedule I, for example, provides details on location of the project, Quantum of water envisaged in the project, water quantity meant for irrigation at the project conception stage and actual details of quantum of water for irrigation currently. The objective was to use this data to identify two major and four medium projects covering the gap distribution of the projects at the state level.

For the selected projects, the study team intended to get distributaries wise data for the last five years. These particulars would have helped the study team to select distributaries covering all possible gap distributions.

In order to proceed in that direction, state level workshops were organized in each major state to inform the officials about the importance of the study and the need for data in the formats supplied by IIMB. However, due to a number of reasons and functional problems, no state was able to provide data in these formats. The study team was informed that it was not possible to provide details for all the projects.

Because of the above constraints projects had to be selected based on extensive discussions with Nodal Officers and other officials available at the State Headquarters. The selected projects, according to the department officials, represented fairly accurately the position with respect to the gap in that particular state. The project selected is provided in Table 3-1. The study team requested the officials to provide information at least for selected projects distributory-wise. However, the study team again met enormous difficulties in obtaining the information for all the distributaries in the selected projects. Sketchy information was made available in most of the cases. Due to this difficulty, a meeting of all the Nodal officials was held in Bangalore to identify the main canals from each of the selected major, medium projects. The Nodal officers were requested to select two distributaries for each of the selected main canals and villages representing head reach, middle reach and tail end of the distributaries. Finally the study team was able to obtain the list of selected villages for each of the sample projects.

Table 3.1 Details of Major and Medium Projects Selected for Primary Survey

Name of the state	Major	Medium
Andhra Pradesh	Nagarjun sagar Project	Boggulavagu Project
	Sriram Sagar project	Sarala Sagar Project
		Sanjeevaiah Sagar Project
		Bhairavani Tippa Project
		Gandipalem Irrigation Project
Karnataka	V. V. Sagar Project	Upper Mullamari Project
	Ghataprabha (Gokak Canal) Project	Hagaribommanahalli Project

		Maskinala (Sriramadevaru) Project
		Anjanapura Project
Tamil Nadu	LBB (Erode)	PRS (Thiruchirapalli)
	SLBC (Thiruvannamalai)	SMR (Ariyalur)
Kerala	Kuttiyadi Irrigation Project	Mangalam Irrigation Project
	Periyar Valley Irrigation Project	Walayar Irrigation Project
		Vazhani Irrigation Project
		Cheerakuzhi Irrigation Project
Maharashtra	Nira RBC Project	Basappachi Wadi Project
	Upper Wardha Project	Chargaon Project
		Morna Project
		Girija Project
		Natuwadi Project
		Waghad Project
Goa	None	Salaulim Irrigation Project (SIP)
	None	Anjunem Irrigation Project (AIP)

This whole process of selecting the villages for primary data collection took about 8-9 months which was supposed to have been completed within 3 months. Thus, there was a time over run for the project. The secondary data received from all the states is provided in Annexure-5.

3.1.1 Analysis of Secondary Data

The schedules for collection of secondary data were prepared and sent to the respective state irrigation departments. Unfortunately, the irrigation departments of all the states could not provide the required data in the format supplied by us. Nevertheless, few states were able to provide data for a few major projects. They have used their own formats which are completely different from the one supplied by us. Thus, there was no uniformity in the data supplied by different states. Consequently, it was not possible to identify the reasons and quantify the gap

according to the specific reasons. However, the available data was analyzed and the gaps along with the reasons are quantified wherever possible. The same is presented in Tables 3.1 A, 3.1 B and 3.1 C. The main difficulty in quantifying the reason is primarily the way the data was captured by the concerned departments. To alleviate this problem, a detailed methodology for data collection and analysis is presented in Chapter 10.

Yes, it is the deficient rainfall in the catchment area that is responsible for the gap.

The Tables 3.1A, 3.1B and 3.1C provide the reasons for each season as given by the irrigation departments of the concerned states. These were retained as they were given in order to highlight the way in which the data was supplied by the concerned departments.

Table 3.1 A – Karnataka Project 1 Data for Water Supply - 2002-03					
Project	Season	Reasons	Water to be supplied	Water actrually suppled	Percentage Gap
D.D.URS Canal	Khariff	Cropping pattern (Violation)	0.061	0	100.00
		Water allowed on trial basis	4.826	0	100.00
	Khariff Total		4.887	0	100.00
	Summer	Reduction in yield	3.967	0	100.00
	Summer Total		3.967	0	100.00
D.D.URS Canal Total			8.854	0	100.00
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	Water logged area	0.783	2.072	-164.62
	Khariff Total		0.783	2.072	-164.62
	Summer	Water logged area	0.783	0	100.00
	Summer Total		0.783	0	100.00
Kabini Reservoir Project (Flow) - Left bank canal Total			1.566	2.072	-32.31
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	Cropping pattern (Violation)	4.68	12.139	-159.38
		No reduction	1.426	2.406	-68.72
		Water could not be supplied to full extent	0.162	0.1	38.27
		Water logged area and ryots are not utilised the water in the tailend of distry	10.189	14.903	-46.27
	Khariff Total		16.457	29.548	-79.55
	Summer	Reduction in yield	5.436	0	100.00

		Water logged area and ryots are not utilised the water in the tailend of distry	7.409	0	100.00
		(blank)	0.574	0	100.00
	Summer Total		13.419	0	100.00
Kabini Reservoir Project (Flow) - Right bank canal Total			29.876	29.548	1.10
Grand Total			40.296	31.62	21.53
Data for Water Supply 2003-04					
Project	Season	Reasons	Water to be supplied	Water actrually suppled	Percentage Gap
D.D.URS Canal	Khariff	No reduction	0.061	0.119	-95.08
		Water allowed on trial basis	4.826	0	100.00
	Khariff Total		4.887	0.119	97.56
	Summer	Reduction in yield	3.3343	0	100.00
	Summer Total		3.3343	0	100.00
D.D.URS Canal Total			8.2213	0.119	98.55
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	No reduction	0.783	0.666	14.94
	Khariff Total		0.783	0.666	14.94
	Summer	No reduction	0.783	0	100.00
	Summer Total		0.783	0	100.00
Kabini Reservoir Project (Flow) - Left bank canal Total			1.566	0.666	57.47
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	No reduction	16.457	23.937	-45.45
	Khariff Total		16.457	23.937	-45.45
	Summer	Reduction in yield	14.118	0	100.00
	Summer Total		14.118	0	100.00

Kabini Reservoir Project (Flow) - Right bank canal Total			30.575	23.937	21.71
Grand Total			40.3623	24.722	38.75

Data for Water Supplied 2004-05					
Project	Season	Reasons	Water to be supplied	Water actrually suppled	Percentage Gap
D.D.URS Canal	Khariff	No reduction	0.061	0.137	-124.59
		Water allowed on trial basis	4.826	0	100.00
	Khariff Total		4.887	0.137	97.20
	Summer	Reduction in yield	3.967	0	100.00
	Summer Total		3.967	0	100.00
D.D.URS Canal Total			8.854	0.137	98.45
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	No reduction	0.783	0.894	-14.18
	Khariff Total		0.783	0.894	-14.18
	Summer	No reduction	0.783	0.433	44.70
	Summer Total		0.783	0.433	44.70
Kabini Reservoir Project (Flow) - Left bank canal Total			1.566	1.327	15.26
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	No reduction	16.457	26.523	-61.17
	Khariff Total		16.457	26.523	-61.17
	Summer	No reduction	0.597	0.909	-52.26
		Reduction in yield	13.521	3.798	71.91
	Summer Total		14.118	4.707	66.66
Kabini Reservoir Project (Flow) - Right bank canal			30.575	31.23	-2.14

Total					
Grand Total			40.995	32.694	20.25
Data for Water Supplied 2005-06					
Project	Season	Reasons	Water to be supplied	Water actrually suppled	Percentage Gap
D.D.URS Canal	Khariff	No reduction	0.061	0.143	-134.43
		Water allowed on trial basis	4.826	0	100.00
	Khariff Total		4.887	0.143	97.07
	Summer	Reduction in yield	3.967	0	100.00
	Summer Total		3.967	0	100.00
D.D.URS Canal Total			8.854	0.143	98.38
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	No reduction	0.783	0.887	-13.28
	Khariff Total		0.783	0.887	-13.28
	Summer	No reduction	0.783	0.648	17.24
	Summer Total		0.783	0.648	17.24
Kabini Reservoir Project (Flow) - Left bank canal Total			1.566	1.535	1.98
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	No reduction	16.457	25.71	-56.23
	Khariff Total		16.457	25.71	-56.23
	Summer	No reduction	0.597	0.985	-64.99
		Reduction in yield	12.822	6.972	45.62
	Summer Total		13.419	7.957	40.70
Kabini Reservoir Project (Flow) - Right bank canal Total			29.876	33.667	-12.69
Grand Total			40.296	35.345	12.29

Data for Water Supplied 2006-07					
Project	Season	Reasons	Water to be supplied	Water actrually suppled	Percentage Gap
D.D.URS Canal	Khariff	No reduction	0.061	0.257	-321.31
		Water allowed on trial basis	4.826	0	100.00
	Khariff Total		4.887	0.257	94.74
	Summer	Reduction in yield	3.967	0	100.00
	Summer Total		3.967	0	100.00
D.D.URS Canal Total			8.854	0.257	97.10
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	No reduction	0.783	1.203	-53.64
	Khariff Total		0.783	1.203	-53.64
	Summer	No reduction	0.783	0.863	-10.22
	Summer Total		0.783	0.863	-10.22
Kabini Reservoir Project (Flow) - Left bank canal Total			1.566	2.066	-31.93
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	No reduction	16.457	28.291	-71.91
	Khariff Total		16.457	28.291	-71.91
	Summer	No reduction	0.597	0.993	-66.33
		Reduction in yield	12.822	3.038	76.31
	Summer Total		13.419	4.031	69.96
Kabini Reservoir Project (Flow) - Right bank canal Total			29.876	32.322	-8.19
Grand Total			40.296	34.645	14.02

Table 3.1 A (Continued) – Project 1

Data for Area 2002-03					
Project	Season	Reasons	IPC	IPU	Gap
D.D.URS Canal	Khariff	Cropping pattern (Violation)	388	0	100.00
		Water allowed on trial basis	31882	0	100.00
	Khariff Total		32270	0	100.00
	Summer	Reduction in yield	26133.008	0	100.00
	Summer Total		26133.008	0	100.00
D.D.URS Canal Total			58403.008	0	100.00
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	Water logged area	1033	993.77	3.80
	Khariff Total		1033	993.77	3.80
	Summer	Water logged area	1033	0	100.00
	Summer Total		1033	0	100.00
Kabini Reservoir Project (Flow) - Left bank canal Total			2066	993.77	51.90
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	Cropping pattern (Violation)	21689	13411.84	38.16
		No reduction	2707	2459	9.16
		Water could not be supplied to full extent	750	110	85.33
		Water logged area and ryots are not utilised the water in the tailend of distry	19370	16464.5	15.00
	Khariff Total		44516	32445.34	27.12
	Summer	Reduction in yield	16724	0	100.00
		Water logged area and ryots are not utilised the water in the tailend of distry	22795	0	100.00
		(blank)	1759	0	100.00

	Summer Total		41278	0	100.00
Kabini Reservoir Project (Flow) - Right bank canal Total			85794	32445.34	62.18
Grand Total			146263.008	33439.11	77.14

Data for Area 2003-04					
Project	Season	Reasons	IPC	IPU	Gap
D.D.URS Canal	Khariff	Cropping pattern (Violation)	388	239.51	38.27
		Water allowed on trial basis	31882	0	100.00
	Khariff Total		32270	239.51	99.26
	Summer	Reduction in yield	26182	0	100.00
	Summer Total		26182	0	100.00
D.D.URS Canal Total			58452	239.51	99.59
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	Water logged area	1033	995.9	3.59
	Khariff Total		1033	995.9	3.59
	Summer	Water logged area	1033	0	100.00
	Summer Total		1033	0	100.00
Kabini Reservoir Project (Flow) - Left bank canal Total			2066	995.9	51.80
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	Cropping pattern (Violation)	21689	10535.91	51.42
		No reduction	2707	2459	9.16
		Water could not be supplied to full extent	750	110	85.33
		Water logged area and ryots are not utilised the water in the tailend of distry	19370	16164.5	16.55
	Khariff Total		44516	29269.41	34.25
	Summer	Reduction in yield	19962	0	100.00

		Water logged area and ryots are not utilised the water in the tailend of distry	22795	0	100.00
		(blank)	1759	0	100.00
	Summer Total		44516	0	100.00
Kabini Reservoir Project (Flow) - Right bank canal Total			89032	29269.41	67.12
Grand Total			149550	30504.82	79.60

Data for Area 2004-05					
Project	Season	Reasons	IPC	IPU	Gap
D.D.URS Canal	Khariff	Cropping pattern (Violation)	388	271.7	29.97
		Water allowed on trial basis	31882	0	100.00
	Khariff Total		32270	271.7	99.16
	Summer	Reduction in yield	26182	0	100.00
	Summer Total		26182	0	100.00
D.D.URS Canal Total			58452	271.7	99.54
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	Water logged area	1033	1002.77	2.93
	Khariff Total		1033	1002.77	2.93
	Summer	Water logged area	1033	987.74	4.38
	Summer Total		1033	987.74	4.38
Kabini Reservoir Project (Flow) - Left bank canal Total			2066	1990.51	3.65
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	Cropping pattern (Violation)	21689	24724.09	-13.99
		No reduction	2707	2459	9.16
		Water could not be supplied to full extent	750	110	85.33

		Water logged area and ryots are not utilised the water in the tailend of distry	19370	16464.5	15.00
	Khariff Total		44516	43757.59	1.70
	Summer	Reduction in yield	19962	72	99.64
		Water logged area and ryots are not utilised the water in the tailend of distry	22795	7640	66.48
		(blank)	1759	1759	0.00
	Summer Total		44516	9471	78.72
Kabini Reservoir Project (Flow) - Right bank canal Total			89032	53228.59	40.21
Grand Total			149550	55490.8	62.89

Data for Area - 2005-06					
Project	Season	Reasons	IPC	IPU	Gap
D.D.URS Canal	Khariff	Cropping pattern (Violation)	388	286.23	26.23
		Water allowed on trial basis	31882	0	100.00
	Khariff Total		32270	286.23	99.11
	Summer	Reduction in yield	26182	0	100.00
	Summer Total		26182	0	100.00
D.D.URS Canal Total			58452	286.23	99.51
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	Water logged area	1033	996.9	3.49
	Khariff Total		1033	996.9	3.49
	Summer	Water logged area	1033	731.32	29.20
	Summer Total		1033	731.32	29.20
Kabini Reservoir Project (Flow) - Left bank canal Total			2066	1728.22	16.35
Kabini Reservoir Project (Flow) - Right	Khariff	Cropping pattern (Violation)	21689	17202.71	20.68

Project (Flow) - Right bank canal		No reduction	2707	2459	9.16
		Water could not be supplied to full extent	750	110	85.33
		Water logged area and ryots are not utilised the water in the tailend of distry	19370	17416.3	10.09
	Khariff Total		44516	37188.01	16.46
	Summer	No reduction	1831	1831	0.00
		Reduction in yield	16652	0	100.00
		Water logged area and ryots are not utilised the water in the tailend of distry	22795	12963	43.13
	Summer Total		41278	14794	64.16
Kabini Reservoir Project (Flow) - Right bank canal Total			85794	51982.01	39.41
Grand Total			146312	53996.46	63.09

Data for Area - 2006-07					
Project	Season	Reasons	IPC	IPU	Gap
D.D.URS Canal	Khariff	Cropping pattern (Violation)	388	291.68	24.82
		Water allowed on trial basis	31882	0	100.00
	Khariff Total		32270	291.68	99.10
	Summer	Reduction in yield	26182	0	100.00
	Summer Total		26182	0	100.00
D.D.URS Canal Total			58452	291.68	99.50
Kabini Reservoir Project (Flow) - Left bank canal	Khariff	Water logged area	1033	982.9	4.85
	Khariff Total		1033	982.9	4.85
	Summer	Water logged area	1033	856.37	17.10
	Summer Total		1033	856.37	17.10
Kabini Reservoir Project (Flow) - Left			2066	1839.27	10.97

bank canal Total					
Kabini Reservoir Project (Flow) - Right bank canal	Khariff	Cropping pattern (Violation)	21689	17175.71	20.81
		No reduction	2707	2458	9.20
		Water could not be supplied to full extent	750	110	85.33
		Water logged area and ryots are not utilised the water in the tailend of distry	19370	18368.1	5.17
	Khariff Total		44516	38111.81	14.39
	Summer	No reduction	1831	1831	0.00
		Reduction in yield	16652	0	100.00
		Water logged area and ryots are not utilised the water in the tailend of distry	22765	8127	64.30
	Summer Total		41248	9958	75.86
Kabini Reservoir Project (Flow) - Right bank canal Total			85764	48069.81	43.95
Grand Total			146282	50200.76	65.68

Table 3.1 A (Continued) – Project 2

Water Supplied GAP Project 2 - 2002-03					
Project	Season	Reasons	Water to be supplied	Water actually supplied	Percentage Gap
Hagaribommanahalli - LBC	NA	Reduction on rain fall	9.4	0	100.00
		(blank)	58.94	0	100.00
	NA Total		68.34	0	100.00
Hagaribommanahalli - LBC Total			68.34	0	100.00
Hagaribommanahalli - RBC	NA	Reduction on rain fall	4.13	0	100.00
		(blank)	56.84	0	100.00
	NA Total		60.97	0	100.00
Hagaribommanahalli - RBC Total			60.97	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	14.3	0	100.00
	NA Total		14.3	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			14.3	0	100.00
Odderhatti Camp	NA	(blank)	27.901	26.313	5.69
	NA Total		27.901	26.313	5.69
Odderhatti Camp Total			27.901	26.313	5.69
RB HLC Distributaries	NA	(blank)	0.1341	0.0894	33.33
	NA Total		0.1341	0.0894	33.33
RB HLC Distributaries Total			0.1341	0.0894	33.33

RB LLC	Khariff	(blank)	0.420783	0.420783	0.00
	Khariff Total		0.420783	0.420783	0.00
	Rabi	(blank)	0.0348	0.0306	12.07
	Rabi Total		0.0348	0.0306	12.07
RB LLC Total			0.455583	0.451383	0.92
TBP- RB HLC	NA	(blank)	1.776	1.208	31.98
	NA Total		1.776	1.208	31.98
TBP- RB HLC Total			1.776	1.208	31.98
TBP- RB LLC	NA	(blank)	2.265	1.858	17.97
	NA Total		2.265	1.858	17.97
TBP- RB LLC Total			2.265	1.858	17.97
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	0.871	0.397	54.42
		(blank)	34.212	13.292	61.15
	Khariff Total		35.083	13.689	60.98
	Rabi	(blank)	0	0	
	Rabi Total		0	0	
Tungabhadra Project Total			35.083	13.689	60.98
Grand Total			211.224683	43.608783	79.35
Water Supplied GAP Project 2 - 2003-04					
Project	Season	Reasons	Water to be supplied	Water actually supplied	Percentage Gap

Hagaribommanahalli - LBC	NA	Reduction on rain fall	9.4	0	100.00
		(blank)	58.94	0	100.00
	NA Total		68.34	0	100.00
Hagaribommanahalli - LBC Total			68.34	0	100.00
Hagaribommanahalli - RBC	NA	Reduction on rain fall	4.13	0	100.00
		(blank)	56.84	0	100.00
	NA Total		60.97	0	100.00
Hagaribommanahalli - RBC Total			60.97	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	14.3	0	100.00
	NA Total		14.3	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			14.3	0	100.00
Odderhatti Camp	NA	(blank)	27.901	26.313	5.69
	NA Total		27.901	26.313	5.69
Odderhatti Camp Total			27.901	26.313	5.69
RB HLC Distributaries	NA	(blank)	0.1341	0.0894	33.33
	NA Total		0.1341	0.0894	33.33
RB HLC Distributaries Total			0.1341	0.0894	33.33
RB LLC	Khariff	(blank)	0.420783	0.420783	0.00
	Khariff Total		0.420783	0.420783	0.00
	Rabi	(blank)	0.0348	0.0306	12.07
	Rabi Total		0.0348	0.0306	12.07

RB LLC Total			0.455583	0.451383	0.92
TBP- RB HLC	NA	(blank)	1.855	1.276	31.21
	NA Total		1.855	1.276	31.21
TBP- RB HLC Total			1.855	1.276	31.21
TBP- RB LLC	NA	(blank)	2.148	1.982	7.73
	NA Total		2.148	1.982	7.73
TBP- RB LLC Total			2.148	1.982	7.73
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	0.26	0.987	-279.62
		(blank)	14.015	13.65	2.60
	Khariff Total		14.275	14.637	-2.54
	Rabi	(blank)	0	0	
	Rabi Total		0	0	
Tungabhadra Project Total			14.275	14.637	-2.54
Grand Total			190.378683	44.748783	76.49
Water Supplied GAP Project 2 - 2004-05					
Project	Season	Reasons	Water to be supplied	Water actually supplied	Percentage Gap
Hagaribommanahalli - LBC	NA	(blank)	68.34	45.729	33.09
	NA Total		68.34	45.729	33.09
Hagaribommanahalli - LBC Total			68.34	45.729	33.09
Hagaribommanahalli - RBC	NA	Reduction on rain fall	4.13	1.63	60.53

		(blank)	56.84	37.08	34.76
	NA Total		60.97	38.71	36.51
Hagaribommanahalli - RBC Total			60.97	38.71	36.51
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	14.3	2.325	83.74
	NA Total		14.3	2.325	83.74
Hagaribommanahalli -RBC (Branch Canal) Total			14.3	2.325	83.74
Odderhatti Camp	NA	(blank)	27.901	26.313	5.69
	NA Total		27.901	26.313	5.69
Odderhatti Camp Total			27.901	26.313	5.69
RB HLC Distributaries	NA	(blank)	0.1341	0.0894	33.33
	NA Total		0.1341	0.0894	33.33
RB HLC Distributaries Total			0.1341	0.0894	33.33
RB LLC	Khariff	(blank)	0.420783	0.420783	0.00
	Khariff Total		0.420783	0.420783	0.00
	Rabi	(blank)	0.0348	0.0306	12.07
	Rabi Total		0.0348	0.0306	12.07
RB LLC Total			0.455583	0.451383	0.92
TBP- RB HLC	NA	(blank)	1.574	1.203	23.57
	NA Total		1.574	1.203	23.57
TBP- RB HLC Total			1.574	1.203	23.57
TBP- RB LLC	NA	(blank)	3.495	2.589	25.92
	NA Total		3.495	2.589	25.92

TBP- RB LLC Total			3.495	2.589	25.92
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	0.26	0.624	-140.00
		(blank)	14.015	18.609	-32.78
	Khariff Total		14.275	19.233	-34.73
	Rabi	(blank)	0	0	
	Rabi Total		0	0	
Tungabhadra Project Total			14.275	19.233	-34.73
Grand Total			191.444683	136.642783	28.63
Water Supplied GAP Project 2 - 2005-06					
Project	Season	Reasons	Water to be supplied	Water actually supplied	Percentage Gap
Hagaribommanahalli - LBC	NA	Reduction on rain fall	9.4	0	100.00
		(blank)	58.94	0	100.00
	NA Total		68.34	0	100.00
Hagaribommanahalli - LBC Total			68.34	0	100.00
Hagaribommanahalli - RBC	NA	Reduction on rain fall	4.13	0	100.00
		(blank)	56.84	0	100.00
	NA Total		60.97	0	100.00
Hagaribommanahalli - RBC Total			60.97	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	14.3	0	100.00

(Branch Canal)	NA Total		14.3	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			14.3	0	100.00
Odderhatti Camp	NA	(blank)	27.901	26.313	5.69
	NA Total		27.901	26.313	5.69
Odderhatti Camp Total			27.901	26.313	5.69
RB HLC Distributaries	NA	(blank)	0.1341	0.0894	33.33
	NA Total		0.1341	0.0894	33.33
RB HLC Distributaries Total			0.1341	0.0894	33.33
RB LLC	Khariff	(blank)	0.420783	0.420783	0.00
	Khariff Total		0.420783	0.420783	0.00
	Rabi	(blank)	0.0348	0.0306	12.07
	Rabi Total		0.0348	0.0306	12.07
RB LLC Total			0.455583	0.451383	0.92
TBP- RB HLC	NA	(blank)	1.641	1.28	22.00
	NA Total		1.641	1.28	22.00
TBP- RB HLC Total			1.641	1.28	22.00
TBP- RB LLC	NA	(blank)	3.849	3.13	18.68
	NA Total		3.849	3.13	18.68
TBP- RB LLC Total			3.849	3.13	18.68
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	0.26	0.768	-195.38

		(blank)	14.015	23.051	-64.47
	Khariff Total		14.275	23.819	-66.86
	Rabi	(blank)	0	0	
	Rabi Total		0	0	
Tungabhadra Project Total			14.275	23.819	-66.86
Grand Total			191.865683	55.082783	71.29
Water Supplied GAP Project 2 - 2006-07					
Project	Season	Reasons	Water to be supplied	Water actually supplied	Percentage Gap
Hagaribommanahalli - LBC	NA	Reduction on rain fall	9.4	0	100.00
		(blank)	58.94	0	100.00
	NA Total		68.34	0	100.00
Hagaribommanahalli - LBC Total			68.34	0	100.00
Hagaribommanahalli - RBC	NA	Reduction on rain fall	4.13	0	100.00
		(blank)	56.84	0	100.00
	NA Total		60.97	0	100.00
Hagaribommanahalli - RBC Total			60.97	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	14.3	0	100.00
	NA Total		14.3	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			14.3	0	100.00
Odderhatti Camp	NA	(blank)	27.901	26.313	5.69
	NA Total		27.901	26.313	5.69

Odderhatti Camp Total			27.901	26.313	5.69
RB HLC Distributaries	NA	(blank)	0.1341	0.0894	33.33
	NA Total		0.1341	0.0894	33.33
RB HLC Distributaries Total			0.1341	0.0894	33.33
RB LLC	Khariff	(blank)	0.420783	0.420783	0.00
	Khariff Total		0.420783	0.420783	0.00
	Rabi	(blank)	0.0348	0.0306	12.07
	Rabi Total		0.0348	0.0306	12.07
RB LLC Total			0.455583	0.451383	0.92
TBP- RB HLC	NA	(blank)	1.613	1.507	6.57
	NA Total		1.613	1.507	6.57
TBP- RB HLC Total			1.613	1.507	6.57
TBP- RB LLC	NA	(blank)	3.554	2.843	20.01
	NA Total		3.554	2.843	20.01
TBP- RB LLC Total			3.554	2.843	20.01
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	0.26	0.719	-176.54
		(blank)	14.015	20.15	-43.77
	Khariff Total		14.275	20.869	-46.19
	Rabi	(blank)	0	0	
	Rabi Total		0	0	
Tungabhadra Project Total			14.275	20.869	-46.19

Grand Total			191.542683	52.072783	72.81

Gap in Area Irrigated - 2002-03					
Project	Season	Reasons	IPC	IPU	Gap (%)
Hagaribommanahalli - LBC	NA	(blank)	1375.7	0	100.00
	NA Total		1375.7	0	100.00
Hagaribommanahalli - LBC Total			1375.7	0	100.00
Hagaribommanahalli - RBC	NA	Reduction on rain fall	39.69	0	100.00
		(blank)	1195.92	0	100.00
	NA Total		1235.61	0	100.00
Hagaribommanahalli - RBC Total			1235.61	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	359.37	0	100.00
	NA Total		359.37	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			359.37	0	100.00
Odderhatti Camp	NA	(blank)	46309.77	35267.79	23.84
	NA Total		46309.77	35267.79	23.84
Odderhatti Camp Total			46309.77	35267.79	23.84
RB HLC Distributaries	NA	(blank)	63002.62	52589	16.53
	NA Total		63002.62	52589	16.53
RB HLC Distributaries Total			63002.62	52589	16.53
RB LLC	Khariff	(blank)	2089.28	3936	-88.39
	Khariff Total		2089.28	3936	-88.39
	Rabi	(blank)	14458	8135	43.73
	Rabi Total		14458	8135	43.73
RB LLC Total			16547.28	12071	27.05

TBP- RB HLC	NA	(blank)	9098.41	8534.57	6.20
	NA Total		9098.41	8534.57	6.20
TBP- RB HLC Total			9098.41	8534.57	6.20
TBP- RB LLC	NA	(blank)	8340.85	3794.34	54.51
	NA Total		8340.85	3794.34	54.51
TBP- RB LLC Total			8340.85	3794.34	54.51
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	3118.32	2405	22.88
		(blank)	163180.93	91360.84	44.01
	Khariff Total		166299.25	93765.84	43.62
	Rabi	(blank)	30213	6	99.98
	Rabi Total		30213	6	99.98
Tungabhadra Project Total			196512.25	93771.84	52.28
Grand Total			342781.86	206028.54	39.90

Gap in Area Irrigated - 2003-04

Project	Season	Reasons	IPC	IPU	Gap (%)
Hagaribommanahalli - LBC	NA	(blank)	1375.7	0	100.00
	NA Total		1375.7	0	100.00
Hagaribommanahalli - LBC Total			1375.7	0	100.00
Hagaribommanahalli - RBC	NA	(blank)	1235.61	0	100.00
	NA Total		1235.61	0	100.00
Hagaribommanahalli - RBC Total			1235.61	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	359.37	0	100.00

(Branch Canal)	NA Total		359.37	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			359.37	0	100.00
Odderhatti Camp	NA	(blank)	46309.77	39866.97	13.91
	NA Total		46309.77	39866.97	13.91
Odderhatti Camp Total			46309.77	39866.97	13.91
RB HLC Distributaries	NA	(blank)	63002.62	45064	28.47
	NA Total		63002.62	45064	28.47
RB HLC Distributaries Total			63002.62	45064	28.47
RB LLC	Khariff	(blank)	2089.28	4777	-128.64
	Khariff Total		2089.28	4777	-128.64
	Rabi	(blank)	14458	7791	46.11
	Rabi Total		14458	7791	46.11
RB LLC Total			16547.28	12568	24.05
TBP- RB HLC	NA	(blank)	9098.41	7740.29	14.93
	NA Total		9098.41	7740.29	14.93
TBP- RB HLC Total			9098.41	7740.29	14.93
TBP- RB LLC	NA	(blank)	8340.85	3986.26	52.21
	NA Total		8340.85	3986.26	52.21
TBP- RB LLC Total			8340.85	3986.26	52.21
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	580.68	2530	-335.70
		(blank)	54173.27	87427.45	-61.38
	Khariff Total		54753.95	89957.45	-64.29

	Rabi	(blank)	794768	0	100.00
	Rabi Total		794768	0	100.00
Tungabhadra Project Total			849521.95	89957.45	89.41
Grand Total			995791.56	199182.97	80.00

Gap in Area Irrigated - 2004-05

Project	Season	Reasons	IPC	IPU	Gap (%)
Hagaribommanahalli - LBC	NA	(blank)	1375.7	951.71	30.82
	NA Total		1375.7	951.71	30.82
Hagaribommanahalli - LBC Total			1375.7	951.71	30.82
Hagaribommanahalli - RBC	NA	(blank)	1235.61	792.72	35.84
	NA Total		1235.61	792.72	35.84
Hagaribommanahalli - RBC Total			1235.61	792.72	35.84
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	359.37	69.5	80.66
	NA Total		359.37	69.5	80.66
Hagaribommanahalli -RBC (Branch Canal) Total			359.37	69.5	80.66
Odderhatti Camp	NA	(blank)	46309.77	31915.62	31.08
	NA Total		46309.77	31915.62	31.08
Odderhatti Camp Total			46309.77	31915.62	31.08
RB HLC Distributaries	NA	(blank)	63002.62	52899	16.04
	NA Total		63002.62	52899	16.04
RB HLC Distributaries Total			63002.62	52899	16.04
RB LLC	Khariff	(blank)	2089.28	5314	-154.35
	Khariff Total		2089.28	5314	-154.35
	Rabi	(blank)	14458	9023	37.59

	Rabi Total		14458	9023	37.59
RB LLC Total			16547.28	14337	13.36
TBP- RB HLC	NA	(blank)	9098.41	8608.86	5.38
	NA Total		9098.41	8608.86	5.38
TBP- RB HLC Total			9098.41	8608.86	5.38
TBP- RB LLC	NA	(blank)	8340.85	7701.48	7.67
	NA Total		8340.85	7701.48	7.67
TBP- RB LLC Total			8340.85	7701.48	7.67
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	580.68	3074	-429.38
		(blank)	54173.27	105459.9	-94.67
	Khariff Total		54753.95	108533.9	-98.22
	Rabi	(blank)	794768	16936	97.87
	Rabi Total		794768	16936	97.87
Tungabhadra Project Total			849521.95	125469.9	85.23
Grand Total			995791.56	242745.79	75.62

Gap in Area Irrigated - 2005-06

Project	Season	Reasons	IPC	IPU	Gap (%)
Hagaribommanahalli - LBC	NA	(blank)	1375.7	0	100.00
	NA Total		1375.7	0	100.00
Hagaribommanahalli - LBC Total			1375.7	0	100.00
Hagaribommanahalli - RBC	NA	(blank)	1235.61	0	100.00
	NA Total		1235.61	0	100.00

Hagaribommanahalli - RBC Total			1235.61	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	359.37	0	100.00
	NA Total		359.37	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			359.37	0	100.00
Odderhatti Camp	NA	(blank)	46309.77	26716.72	42.31
	NA Total		46309.77	26716.72	42.31
Odderhatti Camp Total			46309.77	26716.72	42.31
RB HLC Distributaries	NA	(blank)	63002.62	52916	16.01
	NA Total		63002.62	52916	16.01
RB HLC Distributaries Total			63002.62	52916	16.01
RB LLC	Khariff	(blank)	2089.28	3726	-78.34
	Khariff Total		2089.28	3726	-78.34
	Rabi	(blank)	14458	9307	35.63
	Rabi Total		14458	9307	35.63
RB LLC Total			16547.28	13033	21.24
TBP- RB HLC	NA	(blank)	9098.41	8458.48	7.03
	NA Total		9098.41	8458.48	7.03
TBP- RB HLC Total			9098.41	8458.48	7.03
TBP- RB LLC	NA	(blank)	8340.85	9147.62	-9.67
	NA Total		8340.85	9147.62	-9.67
TBP- RB LLC Total			8340.85	9147.62	-9.67
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	580.68	4789	-724.72
		(blank)	54173.27	131221.3	-142.23

	Khariff Total		54753.95	136010.3	-148.40
	Rabi	(blank)	794768	39774	95.00
	Rabi Total		794768	39774	95.00
Tungabhadra Project Total			849521.95	175784.3	79.31
Grand Total			995791.56	286056.12	71.27
Gap in Area Irrigated - 2006-07					
Project	Season	Reasons	IPC	IPU	Gap (%)
Hagaribommanahalli - LBC	NA	(blank)	1375.7	0	100.00
	NA Total		1375.7	0	100.00
Hagaribommanahalli - LBC Total			1375.7	0	100.00
Hagaribommanahalli - RBC	NA	(blank)	1235.61	0	100.00
	NA Total		1235.61	0	100.00
Hagaribommanahalli - RBC Total			1235.61	0	100.00
Hagaribommanahalli -RBC (Branch Canal)	NA	(blank)	359.37	0	100.00
	NA Total		359.37	0	100.00
Hagaribommanahalli -RBC (Branch Canal) Total			359.37	0	100.00
Odderhatti Camp	NA	(blank)	46309.77	26099.14	43.64
	NA Total		46309.77	26099.14	43.64
Odderhatti Camp Total			46309.77	26099.14	43.64
RB HLC Distributaries	NA	(blank)	63002.62	54488.7	13.51
	NA Total		63002.62	54488.7	13.51
RB HLC Distributaries Total			63002.62	54488.7	13.51
RB LLC	Khariff	(blank)	2089.28	5003.5	-139.48
	Khariff Total		2089.28	5003.5	-139.48
	Rabi	(blank)	14458	11155	22.85

	Rabi Total		14458	11155	22.85
RB LLC Total			16547.28	16158.5	2.35
TBP- RB HLC	NA	(blank)	9098.41	8367.7	8.03
	NA Total		9098.41	8367.7	8.03
TBP- RB HLC Total			9098.41	8367.7	8.03
TBP- RB LLC	NA	(blank)	8340.85	7601.66	8.86
	NA Total		8340.85	7601.66	8.86
TBP- RB LLC Total			8340.85	7601.66	8.86
Tungabhadra Project	Khariff	Insufficient Gradient. Violution of cropping pattern. Unauthorised utilasation. Unlined Canals	580.68	3798	-554.06
		(blank)	54173.27	109537.91	-102.20
	Khariff Total		54753.95	113335.91	-106.99
	Rabi	(blank)	794768	36175	95.45
	Rabi Total		794768	36175	95.45
Tungabhadra Project Total			849521.95	149510.91	82.40
Grand Total			995791.56	262226.61	73.67

Table 3.1 B Tamilnadu state

Percentage of Gaps in utilisation over the planned in respect of water resource and irrigated areas under irrigation projects in 2006-07						
	Quantum of water resource (TMC)			**Irrigated area (Ha)**		
Project Type	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Area to be Irrigated (Ha)**	**Area Irrigated (Ha)**	**% of Gap in utilisation over the planned**
Major	61.4487	65.8126	-7.10	109315.45	104064.45	4.80
Medium	2.5998	0.1894	92.72	10221.20	1424.59	86.06
Minor	3.8704	3.3873	12.48	25627.32	19319.15	24.62

				Quantum of water resource (TMC)			
	Irrigation Project	**Type of Project**	**Year**	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Reasons for reduction in water**
1	Sathanur Reservoir (Left Bank Canal)	Major	2002-03	0.0730	0	100.00	
			2003-04	0.0730	0	100.00	
			2004-05	0.0730	0.1100	-50.68	
			2005-06	0.0730	0.0800	-9.59	
			2006-07	0.0730	0.4580	-527.40	
2	Lower Bhavani	Major	2002-03	36.0000	7.9040	78.04	Reduction in rainfall
			2003-04	36.0000	0.0000	100.00	
			2004-05	36.0000	34.8900	3.08	
			2005-06	36.0000	32.9200	8.56	
			2006-07	36.0000	35.2300	2.14	

3	Kodayar	Major	2002-03	25.3757	14.1398	44.28	
			2003-04	25.3757	11.5133	54.63	
			2004-05	25.3757	18.5404	26.94	
			2005-06	25.3757	24.2600	4.40	
			2006-07	25.3757	30.1246	-18.71	

				Quantum of water resource (TMC)			
	Irrigation Project	**Type of Project**	**Year**	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Reasons for reduction in water**
1	Sidhamalli Reservoir	Medium	2002-03	0.0802	0.0148	81.53	
			2003-04	0.1066	0.0262	75.46	
			2004-05	0.1254	0.0362	71.13	
			2005-06	0.1285	0.0380	70.42	
			2006-07	0.0328	0.0025	92.45	
2	Noyyal Orathupalayam Resrvoir	Medium	2002-03	2.3000	0.0000	100.00	Due to polution in water not drawn for irrigation
			2003-04	2.3000	0.0000	100.00	
			2004-05	2.3000	0.0000	100.00	
			2005-06	2.3000	0.0000	100.00	
			2006-07	2.3000	0.0000	100.00	
3	Anaimaduvu Reservoir	Medium	2002-03	0.2670	0.0325	87.83	Reduction in rainfall
			2003-04	0.2670	0.0000	100.00	
			2004-05	0.2670	0.0000	100.00	
			2005-06	0.2670	0.0199	92.56	
			2006-07	0.2670	0.1869	30.00	

				Quantum of water resource (TMC)			
	Irrigation Project	**Type of Project**	**Year**	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Reasons for reduction in water**
1	Nambiyar Reservoir	Minor	2004-05	0.1620	0.0000	100.00	
			2005-06	0.1620	0.0440	72.84	Reduction in rainfall
			2006-07	0.1620	0.0720	55.55	
2	Kodumudiyar Reservoir	Minor	2004-05	0.5140	0.2040	60.31	
			2005-06	0.5140	0.4470	13.04	
			2006-07	0.5140	0.2700	47.47	
3	Poigaiyar Reservoir	Minor	2002-03	0.1383	0.0126	90.88	
			2003-04	0.1383	0.0126	90.88	
			2004-05	0.1383	0.0126	90.88	
			2005-06	0.1383	0.0287	79.25	
			2006-07	0.1383	0.0287	79.25	
4	Kirumampakkam Tank	Minor	2002-03	0.0430	0.0430	0.00	
			2003-04	0.0430	0.0430	0.00	
			2004-05	0.0388	0.0349	9.86	
			2005-06	0.0350	0.0284	18.72	
			2006-07	0.0318	0.0235	26.12	
5	Kariyakoil Reservoir	Minor	2002-03	0.1900	0.0000	100.00	Reduction in rainfall
			2003-04	0.1900	0.0000	100.00	
			2004-05	0.1900	0.1577	17.00	
			2005-06	0.1900	0.1425	25.01	
			2006-07	0.1900	0.1520	20.01	
6	Gadana Reservoir	Minor	2002-03	0.0343	0.0343	0.00	

			2003-04	0.0343	0.0343	0.00	
			2004-05	0.0343	0.0343	0.00	
			2005-06	0.0343	0.0343	0.00	
			2006-07	0.0343	0.0343	0.00	
7	Ramanadhi	Minor	2002-03	1.2800	1.0800	15.63	
			2003-04	1.2800	1.0800	15.63	
			2004-05	1.2800	1.0800	15.63	
			2005-06	1.2800	1.0800	15.63	
			2006-07	1.2800	1.0800	15.63	
8	Karuppanadhi	Minor	2002-03	0.0501	0.0261	47.90	
			2003-04	0.0501	0.0263	47.50	
			2004-05	0.0501	0.0539	-7.58	
			2005-06	0.0501	0.0825	-64.67	
			2006-07	0.0501	0.0728	-45.31	
9	Gundar	Minor	2002-03	0.0102	0.0102	0.00	
10	Adavinainarkol	Minor	2005-06	0.0400	0.2148	-437.00	
			2006-07	0.0400	0.2240	-460.00	
11	Vadakku pachiyar	Minor	2003-04	0.0300	0.0090	70.00	
			2004-05	0.0300	0.0090	70.00	
			2005-06	0.0300	0.0030	90.00	
			2006-07	0.0300	0.0300	0.00	
12	Kodumudiar and Nambiyar	Minor	2005-06	1.4000	1.2400	11.43	Reduction in rainfall
			2006-07	1.4000	1.4000	0.00	

				Irrigated area (Ha)			
	Irrigation Project	**Type of Project**	**Year**	**Area to be Irrigated (Ha)**	**Area Irrigated (Ha)**	**% of Gap in utilisation over the planned**	**Reasons for reduction in area**
1	Sathanur Reservoir (Left Bank Canal)	Major	2002-03	1267.00		100.00	
			2003-04	1267.00		100.00	
			2004-05	1267.00	1267.00	0.00	
			2005-06	1267.00	1267.00	0.00	
			2006-07	1267.00	1267.00	0.00	
2	Lower Bhavani	Major	2002-03	80976.00	22950.00	71.66	
			2003-04	80976.00	0.00	100.00	
			2004-05	80976.00	77360.00	4.47	
			2005-06	80976.00	74315.00	8.23	
			2006-07	80976.00	75725.00	6.48	Cropping pattern
3	Kodayar	Major	2002-03	27072.45	27072.45	0.00	
			2003-04	27072.45	27072.45	0.00	
			2004-05	27072.45	27072.45	0.00	
			2005-06	27072.45	27072.45	0.00	
			2006-07	27072.45	27072.45	0.00	

				Irrigated area (Ha)			
	Irrigation Project	**Type of Project**	**Year**	**Area to be Irrigated (Ha)**	**Area Irrigated (Ha)**	**% of Gap in utilisation over the planned**	**Reasons for reduction in area**
1	Sidhamalli Reservoir	Medium	2002-03	194.87	18.45	90.53	
			2003-04	258.92	32.60	87.41	
			2004-05	304.54	45.10	85.19	

			2005-06	1202.34	702.77	41.55	
			2006-07	100.00	4.86	95.14	
2	Noyyal Orathupalayam Resrvoir	Medium	2002-03	8093.00	0.00	100.00	
			2003-04	8093.00	0.00	100.00	
			2004-05	8093.00	0.00	100.00	
			2005-06	8093.00	0.00	100.00	
			2006-07	8093.00	0.00	100.00	
3	Anaimaduvu Reservoir	Medium	2002-03	2028.20	417.86	79.40	
			2003-04	2028.20	0.00	100.00	
			2004-05	2028.20	0.00	100.00	
			2005-06	2028.20	150.99	92.56	
			2006-07	2028.20	1419.73	30.00	

				Irrigated area (Ha)			
	Irrigation Project	**Type of Project**	**Year**	**Area to be Irrigated (Ha)**	**Area Irrigated (Ha)**	**% of Gap in utilisation over the planned**	**Reasons for reduction in area**
1	Nambiyar Reservoir	Minor	2004-05	706.00	0.00	100.00	
			2005-06	706.00	184.32	73.89	
			2006-07	706.00	371.18	47.42	
2	Kodumudiyar Reservoir	Minor	2004-05	2339.50	807.90	65.47	
			2005-06	2339.50	1811.30	22.58	Change in cropping pattern
			2006-07	2339.50	1034.90	55.76	
3	Poigaiyar Reservoir	Minor	2002-03	383.58	285.58	25.55	
			2003-04	383.58	285.58	25.55	
			2004-05	383.58	285.58	25.55	
			2005-06	383.58	285.58	25.55	
			2006-07	383.58	285.58	25.55	

4	Kirumampakkam Tank	Minor	2002-03	203.00	203.00	0.00	
			2003-04	203.00	203.00	0.00	
			2004-05	183.00	164.97	9.85	
			2005-06	165.00	134.11	18.72	
			2006-07	150.00	110.84	26.11	
5	Kariyakoil Reservoir	Minor	2002-03	1457.05	0.00	100.00	
			2003-04	1457.05	0.00	100.00	
			2004-05	1457.05	1209.36	17.00	
			2005-06	1457.05	1092.79	25.00	
			2006-07	1457.05	1165.54	20.01	
6	Gadana Reservoir	Minor	2002-03	3775.08	3775.08	0.00	
			2003-04	3775.08	3775.08	0.00	
			2004-05	3775.08	3775.08	0.00	
			2005-06	3775.08	3775.08	0.00	
			2006-07	3775.08	3775.08	0.00	
7	Ramanadhi	Minor	2002-03	2001.42	1701.42	14.99	
			2003-04	2001.42	1701.42	14.99	
			2004-05	2001.42	1701.42	14.99	
			2005-06	2001.42	1701.42	14.99	
			2006-07	2001.42	1701.42	14.99	

8	Karuppanadhi	Minor	2002-03	3494.74	3397.10	2.79	
			2003-04	3494.74	2847.45	18.52	
			2004-05	3494.74	3464.70	0.86	
			2005-06	4234.51	4234.51	0.00	
			2006-07	4234.51	4178.20	1.33	
9	Gundar	Minor	2002-03	897.60	897.60	0.00	
10	Adavinainarkol	Minor	2005-06	5222.42	5216.734	0.11	
			2006-07	5222.42	5222.424	0.00	
11	Vadakku pachiyar	Minor	2003-04	3883.77	1165.13	70.00	
			2004-05	3883.77	1165.13	70.00	
			2005-06	3883.77	388.37	90.00	
			2006-07	3883.77	0	100.00	
12	Kodumudiar and Nambiyar	Minor	2005-06	1473.99	769.54	47.79	
			2006-07	1473.99	1473.99	0.00	

	PROJECT 1											
			Irrigation Potential Created (Ha)					Irrigation Potential Utilized				
S No	Project	Distributories	2002-03	2003-04	2004-05	2005-06	2006-07	2002-03	2003-04	2004-05	2005-06	2006-07
1	D.D.URS Canal	DIST 1-11	676	676	676	676	676	0	239.51	271.7	286.23	291.68
		Percentage Utilized						0.00	35.43	40.19	42.34	43.15
2	D.D.URS Canal	DIST 12-105	57727.01	57776	57776	57776	57776	0	0	0	0	0
		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
3	D.D.URS Canal Total		58403.01	58452	58452	58452	58452	0	239.51	271.7	286.23	291.68
		Percentage Utilized						0.00	0.41	0.46	0.49	0.50
4	Kabini Reservoir Project (Flow) - Left bank canal Total		2066	2066	2066	2066	2066	993.77	995.9	1990.51	1728.22	1839.27
		Percentage Utilized						48.10	48.20	96.35	83.65	89.03
5	Kabini Reservoir Project (Flow) - Right bank canal Total	DIST 1-63	81806	81806	81806	81806	81776	32445.34	29269.41	53228.59	51982.01	48069.81
		Percentage Utilized						39.66	35.78	65.07	63.54	58.78
6	Kabini Reservoir Project (Flow) - Right bank canal Total	DPO	750	750	750	750	750	0	0	0	0	0

		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
7	Kabini Reservoir Project (Flow) - Right bank canal Total	TBC	3238	3238	3238	3238	3238	0	0	0	0	0
		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
8	Kabini Reservoir Project (Flow) - Right bank canal Total	DIST DPO&TB C	3988	3988	3988	3988	3988	0	0	0	0	0
		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
9	Kabini Reservoir Project (Flow) - Right bank canal Total		85794	85794	85794	85794	85764	32445.34	29269.41	53228.59	51982.01	48069.81
		Percentage Utilized						37.82	34.12	62.04	60.59	56.05

	PROJECT 2											
			Irrigation Potential Created (Ha)					Irrigation Potential Utilized				
	Project	Distributories	2002-03	2003-04	2004-05	2005-06	2006-07	2002-03	2003-04	2004-05	2005-06	2006-07
1	Hagaribommanahalli - LBC	Total-25 Distributories	1046.82	1046.82	1046.82	1046.82	1046.82	0	0	951.71	0	0
		Percentage Utilized						0.00	0.00	90.91	0.00	0.00
2	Hagaribommanahalli - LBC	Total-5 Distributories	328.88	328.88	328.88	328.88	328.88	0	0	0	0	0
		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
3	Hagaribommanahalli - LBC	ALL	1375.7	1375.7	1375.7	1375.7	1375.7	0	0	951.71	0	0
		Percentage Utilized						0.00	0.00	69.18	0.00	0.00
4	Hagaribommanahalli - RBC	D1	39.69	39.69	39.69	39.69	39.69	0	0	0	0	0
		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
5	Hagaribommanahalli - RBC	D1	39.69	39.69	39.69	39.69	39.69	0	0	0	0	0
		Percentage Utilized						0.00	0.00	0.00	0.00	0.00
6	Hagaribommanahalli - RBC Total	Total - 24 Distributories	1195.92	1195.92	1195.92	1195.92	1195.92	0	0	792.72	0	0
		Percentage Utilized						0.00	0.00	66.29	0.00	0.00
7	Hagaribommanahalli - RBC Total	ALL	1235.61	1235.61	1235.61	1235.61	1235.61	0	0	792.72	0	0
		Percentage Utilized						0.00	0.00	64.16	0.00	0.00
8	Hagaribommanahalli -RBC (Branch Canal) Total	Total - 4 Distributories	359.37	359.37	359.37	359.37	359.37	0	0	69.5	0	0
		Percentage Utilized						0.00	0.00	19.34	0.00	0.00

9	Odderhatti Camp Total	ALL	46309.77	46309.77	46309.77	46309.77	46309.77	35267.79	39866.97	31915.62	26716.72	26099.14
		Percentage Utilized						76.16	86.09	68.92	57.69	56.36
10	RB HLC Distributaries Total	ALL	63002.62	63002.62	63002.62	63002.62	63002.62	52589	45064	52899	52916	54488.7
		Percentage Utilized						83.47	71.53	83.96	83.99	86.49
11	RB LLC	Total - 4 Distributories	4058.72	4058.72	4058.72	4058.72	4058.72	4154	4070	4206	4297	4235.5
		Percentage Utilized						102.35	100.28	103.63	105.87	104.36
12	RB LLC	Total - 3 Distributories	53.89	53.89	53.89	53.89	53.89	0	44	124	0	176
		Percentage Utilized						0.00	81.65	230.10	0.00	326.59
13	RB LLC	Total - 18 Distributories	1143.03	1143.03	1143.03	1143.03	1143.03	2097	2968	3573	1892	2997
		Percentage Utilized						183.46	259.66	312.59	165.52	262.20
14	RB LLC	DP 33A	0	0	0	0	0	199	374	209	195	209
		Percentage Utilized										
15	RB LLC	Total -21 Distributories	11291.64	11291.64	11291.64	11291.64	11291.64	5621	5112	6225	6649	8541
		Percentage Utilized						49.78	45.27	55.13	58.88	75.64
16	RB LLC	Total - 4 Distributories	0	0	0	0	0	0	0	0	0	0
		Percentage Utilized										
17	RB LLC Total		16547.28	16547.28	16547.28	16547.28	16547.28	12071	12568	14337	13033	16158.5
		Percentage Utilized						72.95	75.95	86.64	78.76	97.65

One of the important TOR of the study was to identify the irrigation potential which has been created but (a) has not been utilized, (b) has not been utilized regularly, and (c) has gone into disuse due to various reasons. In order to quantify the above issues, the data need to be provided by the irrigation department at disaggregated distributory level for different years. This point is illustrated on the basis of information received for two projects in the state of Karnataka.

Project 1 refers to Kabini Reservoir project, which consists of DD URS canal, Kabini Left Bank canal and Kabini Right Bank canal.

In the case of DD URS canal for the distributories 1 to 11 the potential created is 676 Ha. However, in the first year (2002-03), the utilization is 0 and it got progressively increased to 43.15 per cent. That means, around 57% was never utilized even after 5 years. For the same canal, for the distributories 12 to 105, even though the potential created is 57,776 ha. the potential was never utilized even once during the last 5 years. The same information if you consider for the URS canal as a whole, the utilization figures to be just 0.5 during the last 5 years. In the case of Kabini Right canal for the distributories 1 to 63, the potential created was of the order of 81,806, whereas the utilization figures show wide variation over the last 5 years with a maximum of 65.07 per cent and a minimum of 35.78 per cent.

In the case of DPO of Right Bank, even though a potential 750 Ha is created, it was never utilized even once during the last 5 years. Same is the situation in the case of TBC. However, if you consider the Kabini Right Bank canal as a whole, the picture that arises is the utilization varies from a high of 62 per cent to a low of 34 per cent. This underscores the importance of the disaggregated distributory level information on potential created and potential utilized.

The Irrigation Department of Karnataka has also provided distributory-wise information on Hagaribommanahalli project. In the case of Left Bank canal, for 25 distributories, the potential created is 1047 Ha, whereas the utilization is 0 for 4 years and 952 Ha was utilized in the year 2004-05. In case of another 5 distributories, the potential created is 329 Ha and this was not utilized even once during the last 5 years. If you consider, the Left Bank canal as a whole, it gives a different picture of utilization for one year at 69 per cent and 0 per cent for 4 years.

Right Bank canal in 1 distributory, the percentage utilization is 0. For 24 distributories, the potential created is 1196 Ha and utilization is 793 Ha for the year 2004-05 and 0 for the other 4

years. But if you consider the entire Right canal, it provides a misleading picture of utilization 64 per cent in one year and 0 per cent in other years.

In the same project, a branch canal of Right canal for 4 distributories, the utilization is only 19 per cent for 1 year and 0 per cent for 4 years. In the case of HLC all the distributories, the utilization is more or less uniform at above 80 per cent except for 1 year at 72 per cent in the year 2003-04. But if you consider the 4 distributories, the potential created is 459 Ha whereas the utilization varies between 100 and 106 per cent. For 3 distributories, there is a wide variation in the utilization with a maximum of 326 per cent in 1 year and 0 per cent for 2 years. When we consider 18 distributores, again the utilization is much higher than 100 per cent for all the five years. In another 21 distributories, the utilization varied from 49 to 75 per cent during the last 5 years. For 4 distributories, potential created is 0 as well as the utilization is 0.

It is interesting to note that in DP 33A, the potential created is 0 during the last five years, whereas the utilization varies from a high of 374 Ha in one year and a low of around 200 Ha in the remaining 4 years. It is not possible to get this picture if the data is aggregated at the main canal level or project level.

For the RB Left Canal as a whole, the potential created is 16,547 Ha and the utilization in percentage term varies from a high of 97 per cent to a low of 73 per cent. Thus, it is very difficult to answer the TOR issues unless disaggregated data at distributory level and the reasons for variation. For these 2 projects, a detailed data provided by Irrigation Department of Karnataka is enclosed in Annexure 5 of the Annexures.

Table 3.1 C – Maharashtra state

Percentage of Gaps in utilisation over the planned in respect of water resource and irrigated areas under irrigation projects in 2006-07						
	Quantum of water resource (TMC)			**Irrigated area (Ha)**		
Project Type	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Area to be Irrigated (Ha)**	**Area Irrigated (Ha)**	**% of Gap in utilisation over the planned**
Major	2812.1090	3639.8162	-29.43	391538.70	497375.89	-27.03
Medium	129.7440	112.5600	13.24	16291.00	13129.90	19.40
Minor	20.7525	14.2949	31.12	6336.00	3901.26	38.43

				Quantum of water resource (TMC)			
	Project	**Project Type**	**Year**	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Reasons for reduction in water**
1	Adan River Project	Major	2002-03	6.9670	4.9790	28.53	
			2003-04	6.9670	0.4850	93.04	
			2004-05	6.9670	0.0000	100.00	
			2005-06	6.9670	3.8510	44.73	
			2006-07	6.9670	4.8620	30.21	
2A	Arunavati RBC	Major	2002-03	4.7000	0.3607	92.33	Poor Maintenance
			2003-04	4.6950	0.1250	97.34	Weed Growth

			2004-05	4.6950	0.0000	100.00	Damage for canal Linning
			2005-06	4.6950	0.3110	93.38	Erosion of side slopes
			2006-07	4.6950	0.6093	87.02	unauthorised pumping
2B	Arunavathi LBC	Major	2002-03	9.1971	1.8654	79.72	Poor Maintenance
			2003-04	9.1971	0.4067	95.58	Weed Growth
			2004-05	9.1971	0.0000	100.00	Damage for canal Linning
			2005-06	9.1971	2.8740	68.75	Erosion of side slopes
			2006-07	9.1971	2.8199	69.34	unauthorised pumping
3	Jayayakwadi	Major	2002-03	1394.0500	404.3030	71.00	
			2003-04	1394.0500	392.6870	71.83	
			2004-05	1394.0500	2129.1410	-52.73	
			2005-06	1394.0500	2171.9350	-55.80	
			2006-07	1394.0500	2171.9350	-55.80	
4	Neera Right Bank Canal Project	Major	2002-03	911.4500	911.4500	0.00	
			2003-04	911.4500	911.4500	0.00	
			2004-05	911.4500	911.4500	0.00	

			2005-06	911.4500	911.4500	0.00	
			2006-07	911.4500	911.4500	0.00	
5	Upper Wardha Project	Major	2002-03	485.7500	419.2400	13.69	
			2003-04	485.7500	614.8000	-26.57	
			2004-05	485.7500	514.2100	-5.86	
			2005-06	485.7500	614.8000	-26.57	
			2006-07	485.7500	548.1400	-12.84	

				Quantum of water resource (TMC)			
	Project	**Project Type**	**Year**	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Reasons for reduction in water**
1	Nawargaon	Medium	2002-03	0.3440	0.2500	27.33	
			2003-04	0.3440	0.2140	37.79	
			2004-05	0.3440	0.0000	100.00	
			2005-06	0.3440	0.1360	60.47	
			2006-07	0.3440	0.1000	70.93	
2	Chargoan	Medium	2002-03	21.7800	25.6900	-17.95	
			2003-04	21.7800	24.9800	-14.69	
			2004-05	21.7800	20.6700	5.10	

			2005-06	21.7800	24.8300	-14.00	
			2006-07	21.7800	23.0000	-5.60	
3	Dongargaon	Medium	2002-03	3.9500	4.6200	-16.96	
			2003-04	3.9500	3.1400	20.51	
			2004-05	3.9500	0.9200	76.71	
			2005-06	3.9500	3.9600	-0.25	
			2006-07	3.9500	4.4900	-13.67	
4	GIRIJA	Medium	2002-03	24.2600	15.5500	35.90	
			2003-04	24.2600	7.6200	68.59	
			2004-05	24.2600	1.4100	94.19	
			2005-06	24.2600	1.4100	94.19	
			2006-07	24.2600	21.2300	12.49	
5	Morna	Medium	2002-03	47.2300	39.4400	16.49	
			2003-04	47.2300	11.4100	75.84	
			2004-05	47.2300	3.8200	91.91	
			2005-06	47.2300	11.1000	76.50	
			2006-07	47.2300	36.5100	22.70	
6	Natuwadi	Medium	2002-03	27.8700	27.2300	2.30	
			2003-04	27.8700	27.2300	2.30	
			2004-05	27.8700	27.2300	2.30	
			2005-06	27.8700	27.2300	2.30	
			2006-07	27.8700	27.2300	2.30	

7	Basappawadi	Medium	2002-03	4.3100	0.0000	100.00	Inandequate sotrage / yield
			2003-04	4.3100	0.0000	100.00	
			2004-05	4.3100	0.0000	100.00	
			2005-06	4.3100	0.0000	100.00	
			2006-07	4.3100	0.0000	100.00	

				Quantum of water resource (TMC)			
	Project	**Project Type**	**Year**	**Created as per Project plan**	**Utilisation**	**% of Gap in utilisation over the planned**	**Reasons for reduction in water**
1	Ner	Minor	2002-03	0.0016	0.0013	21.12	Poor Maintenance
			2003-04	0.0032	0.0019	39.94	Weed Growth
			2004-05	0.0048	0.0010	78.88	silting of canal
			2005-06	0.0064	0.0010	84.01	Less Discharge
			2006-07	0.0081	0.0019	76.43	
2	Wai	Minor	2002-03	0.0084	0.0060	27.89	As per demand of Cultivators
			2003-04	0.0017	0.0067	-304.58	
			2004-05	0.0017	0.0000	100.00	
			2005-06	0.0017	0.0040	-138.41	
			2006-07	0.0017	0.0046	-175.14	
3	Khemkund	Minor	2002-03	0.0009	0.0014	-56.27	As per demand of Cultivators
			2003-04	0.0009	0.0019	-105.03	
			2004-05	0.0009	0.0000	100.00	

			2005-06	0.0009	0.0010	-9.72	
			2006-07	0.0009	0.0008	14.66	
4	Majara	Minor	2002-03	0.0048	0.0028	41.28	
			2003-04	0.0048	0.0021	56.19	
			2004-05	0.0048	0.0000	100.00	
			2005-06	0.0048	0.0013	73.49	
			2006-07	0.0048	0.0007	85.71	
5	Belapur Badgi	Minor	2002-03	2.6800	1.6900	36.94	
			2003-04	2.4000	1.4500	39.58	
			2004-05	2.6800	0.0000	100.00	
			2005-06	2.6800	0.0000	100.00	
			2006-07	2.6800	0.0000	100.00	
6	Bhurikawathe	Minor	2002-03	1.2500		100.00	
			2003-04	1.2500		100.00	
			2004-05	1.2500	0.1400	88.80	
			2005-06	1.2500	0.0700	94.40	
			2006-07	1.2500		100.00	
7	Shirwalwadi	Minor	2002-03	2.9500	0.0000	100.00	
			2003-04	2.9500	0.0000	100.00	
			2004-05	2.9500	1.6500	44.07	
			2005-06	2.9500	0.7500	74.58	
			2006-07	2.9500	0.6200	78.98	

8	Malkhed	Minor	2002-03	7.1400	9.9600	-39.50	
			2003-04	7.1400	5.4400	23.81	
			2004-05	7.1400	1.5860	77.79	
			2005-06	7.1400	9.9600	-39.50	
			2006-07	7.1400	9.9600	-39.50	
9	Khindwadi	Minor	2002-03	1.8470	1.8470	0.00	
			2003-04	1.8470	1.8470	0.00	
			2004-05	1.8470	1.8470	0.00	
			2005-06	1.8470	1.8470	0.00	
			2006-07	1.8470	1.8470	0.00	
10	Wadad	Minor	2002-03	1.8640	1.8120	2.79	
			2003-04	1.8640	1.8600	0.21	
			2004-05	1.8640	0.8400	54.94	
			2005-06	1.8640	1.8600	0.21	
			2006-07	1.8640	1.8600	0.21	
11	Marsul	Minor	2002-03	3.0060	0.0000	100.00	
			2003-04	3.0060	0.0000	100.00	
			2004-05	3.0060	3.0010	0.17	
			2005-06	3.0060	3.0010	0.17	
			2006-07	3.0060	0.0000	100.00	

				Irrigated area (Ha)			
	Project	Project Type	Year	Area to be Irrigated	Area Irrigated	% of Gap in utilisation over the planned	Reasons for reduction in area
1	Adan River Project	Major	2002-03	10067.00	2499.00	75.18	
			2003-04	10067.00	475.63	95.28	
			2004-05	10067.00	0.00	100.00	
			2005-06	10067.00	1326.43	86.82	
			2006-07	10067.00	2049.91	79.64	
2A	Arunavati RBC	Major	2002-03	17780.13	1580.02	91.11	social
			2003-04	17780.13	529.56	97.02	Unevenness of terrain
			2004-05	17780.13	0.00	100.00	
			2005-06	17780.13	678.92	96.18	
			2006-07	17780.13	834.42	95.31	
2B	Arunavathi LBC	Major	2002-03	34614.57	1757.41	94.92	social
			2003-04	34614.57	460.87	98.67	Unevenness of terrain
			2004-05	34614.57	0.00	100.00	
			2005-06	34614.57	1481.34	95.72	
			2006-07	34614.57	1467.56	95.76	
3	Jayayakwadi	Major	2002-03	183322.00	230668.00	-25.83	
			2003-04	183322.00	259045.00	-41.31	
			2004-05	183322.00	320916.00	-75.06	
			2005-06	183322.00	266983.00	-45.64	
			2006-07	183322.00	292556.00	-59.59	

4	Neera Right Bank Canal Project	Major	2002-03	65505.00	126651.00	-93.35	
			2003-04	65505.00	113442.00	-73.18	
			2004-05	65505.00	137642.00	-110.12	
			2005-06	65505.00	147837.00	-125.69	
			2006-07	65505.00	172925.00	-163.99	
5	Upper Wardha Project	Major	2002-03	80250.00	9697.00	87.92	
			2003-04	80250.00	13303.00	83.42	
			2004-05	80250.00	16890.00	78.95	
			2005-06	80250.00	16606.00	79.31	
			2006-07	80250.00	27543.00	65.68	

				Irrigated area (Ha)			
	Project	**Project Type**	**Year**	**Area to be Irrigated**	**Area Irrigated**	**% of Gap in utilisation over the planned**	**Reasons for reduction in area**
1	Nawargaon	Medium	2002-03	2056.00	1063.00	48.30	
			2003-04	2056.00	909.00	55.79	
			2004-05	2056.00	0.00	100.00	
			2005-06	2056.00	576.00	71.98	
			2006-07	2056.00	427.00	79.23	
2	Chargoan	Medium	2002-03	2120.00	2145.69	-1.21	
			2003-04	2120.00	2144.98	-1.18	
			2004-05	2120.00	2140.67	-0.97	
			2005-06	2120.00	2144.83	-1.17	
			2006-07	2120.00	2143.00	-1.08	

3	Dongargaon	Medium	2002-03	608.00	1046.00	-72.04	
			2003-04	608.00	1077.00	-77.14	
			2004-05	608.00	826.00	-35.86	
			2005-06	608.00	975.00	-60.36	
			2006-07	608.00	1017.00	-67.27	
4	GIRIJA	Medium	2002-03	3427.00	1051.00	69.33	
			2003-04	3427.00	1051.00	69.33	
			2004-05	3427.00	1051.00	69.33	
			2005-06	3427.00	1051.00	69.33	
			2006-07	3427.00	1051.00	69.33	
5	Morna	Medium	2002-03	5168.00	5672.00	-9.75	
			2003-04	5168.00	5494.00	-6.31	
			2004-05	5168.00	5199.00	-0.60	
			2005-06	5168.00	5946.00	-15.05	
			2006-07	5168.00	8293.00	-60.47	
6	Natuwadi	Medium	2002-03	2050.00	132.00	93.56	
			2003-04	2050.00	157.25	92.33	
			2004-05	2050.00	180.00	91.22	
			2005-06	2050.00	14.00	99.32	
			2006-07	2050.00	198.90	90.30	
7	Basappawadi	Medium	2002-03	862.00	0.00	100.00	
			2003-04	862.00	0.00	100.00	
			2004-05	862.00	0.00	100.00	

			2005-06	862.00	0.00	100.00	
			2006-07	862.00	0.00	100.00	

				Irrigated area (Ha)			
	Project	**Project Type**	**Year**	**Area to be Irrigated**	**Area Irrigated**	**% of Gap in utilisation over the planned**	**Reasons for reduction in area**
1	Ner	Minor	2002-03	176.00	110.59	37.16	Unevenness of terrain
			2003-04	352.00	300.96	14.50	
			2004-05	527.00	110.83	78.97	
			2005-06	702.00	110.00	84.33	
			2006-07	878.00	208.00	76.31	
2	Wai	Minor	2002-03	1040.00	964.00	7.31	
			2003-04	70.00	783.00	-1018.57	
			2004-05	70.00	0.00	100.00	
			2005-06	70.00	337.00	-381.43	
			2006-07	70.00	480.00	-585.71	
3	Khemkund	Minor	2002-03	513.00	278.00	45.81	
			2003-04	513.00	222.00	56.73	
			2004-05	513.00	0.00	100.00	
			2005-06	513.00	54.00	89.47	
			2006-07	513.00	172.00	66.47	
4	Majara	Minor	2002-03	1229.00	326.00	73.47	
			2003-04	1229.00	232.00	81.12	
			2004-05	1229.00	0.00	100.00	

			2005-06	1229.00	89.00	92.76	
			2006-07	1229.00	65.00	94.71	
5	Belapur Badgi	Minor	2002-03	457.00	273.00	40.26	
			2003-04	457.00	267.00	41.58	
			2004-05	457.00	354.00	22.54	
			2005-06	457.00	325.00	28.88	
			2006-07	457.00	265.00	42.01	
6	Bhurikawathe	Minor	2002-03	232.00		100.00	
			2003-04	232.00		100.00	
			2004-05	232.00	20.00	91.38	
			2005-06	232.00	9.00	96.12	
			2006-07	232.00		100.00	
7	Shirwalwadi	Minor	2002-03	485.00	0.00	100.00	
			2003-04	485.00	0.00	100.00	
			2004-05	485.00	74.00	84.74	
			2005-06	485.00	62.00	87.22	
			2006-07	485.00	31.00	93.61	
8	Malkhed	Minor	2002-03	1583.00	1875.00	-18.45	
			2003-04	1583.00	1552.00	1.96	
			2004-05	1583.00	1105.00	30.20	
			2005-06	1583.00	1795.00	-13.39	
			2006-07	1583.00	2234.00	-41.12	

9	Khindwadi	Minor	2002-03	125.00	67.21	46.23	
			2003-04	125.00	65.11	47.91	
			2004-05	125.00	69.27	44.58	
			2005-06	125.00	72.13	42.30	
			2006-07	125.00	68.26	45.39	
10	Wadad	Minor	2002-03	419.00	190.00	54.65	
			2003-04	419.00	174.00	58.47	
			2004-05	419.00	142.00	66.11	
			2005-06	419.00	699.00	-66.83	
			2006-07	419.00	378.00	9.79	
11	Marsul	Minor	2002-03	345.00	0.00	100.00	
			2003-04	345.00	0.00	100.00	
			2004-05	345.00	637.00	-84.64	
			2005-06	345.00	615.00	-78.26	
			2006-07	345.00	0.00	100.00	

The issue of gap between irrigation potential created and utilization was to be addressed in three successive stages. In the first stage, the macro picture of the gap was to be obtained based on published reports, typically plan documents. In the second stage, it was agreed that the irrigation departments would identify a few projects, major, medium and minor, in each state and gather disaggregated data, related to those projects, on irrigation potential created, actual utilization, suggested cropping pattern vs. actual, size of gap and causes thereof. In the third stage a more in-depth sample survey from the same project areas was to be carried out to get the farm level data on the above variables. The final objective was to integrate the data from all sources and come out with a realistic measure of the size of the gap and that causes thereof.

The information gathered from the first exercise was completed successfully; however, the information is too general. Similarly, in the third stage, the sample survey in the project areas was carried out as planned but the data coming out of the survey cannot be generalized beyond the sample areas. The second stage data was, therefore, crucial to corroborate or otherwise the findings of the other two exercises and take a judgment call on the size of the gap and the reasons for those.

However, the study was handicapped for lack of information at the project level. The data supplied by irrigation department for the states of Tamilnadu and Maharashtra are shown in Tables 3.1 B and 3.1 C. At the aggregate level, in the year 2006-07, for example, there was a wide gap between potential created and actual utilization as also between suggested and actual cropping pattern in Tamilnadu in respect of medium irrigation projects. But not so glaring difference in major and minor projects. But this was not so in Maharashtra.

More importantly, there is a wide variation between years across all types of irrigation in both Tamilnadu and Maharashtra. It is possible to find out the average water utilization and cropping pattern gap in a particular year in each irrigation system. But in the absence of reasons for the gap, it is difficult to normalize and come out with a realistic size of the gap and the reasons for that. The project wise data provided by the irrigation department does not provide adequate information on either reason for reduction of water or area.

In the absence of the above data, the only way to arrive at the size of the gap as also the reasons thereof is to go by the findings of the sample survey data. Since the survey was done in 2006-07,

a cross check can be done with the project level data for that year on both the size of the gap and the reasons, wherever project wise data is available.

3.2 Primary Data Collection

It was agreed at the time of project proposal that primary data would be collected from two major projects, four medium projects and a number of minor projects, covering around 500 households in each state. The schedule was developed and pre-tested to collect primary data from the households situated in different locations of the distributaries.

There is a perception that the farmers situated at the tail-end are not able to get enough quantity water and the gap at the tail end is very high compared to head reaches. In order to verify this aspect, care as been taken to obtain information from the farmers situated at the tail-end. Another schedule covering the officials at the local level is administered i.e. manning the main canal and distributaries of the project, in order to obtain the information on gap and their views on the gap. These schedules are presented in annexure 2& 3. The details regarding village, district and the location in the distributaries and number of farmers covered in each village is presented in Table 3.2. Thus the primary surveys covered a total of 68 Districts, and 283 villages. It is felt that this sample was representative of the actual scenario prevailing in the study region.

Table 3.2 Details of Villages, Location of Distributaries and Number of Farmers Interviewed

ANDHRA PRADESH		Project Type								
		Major	Medium	Minor	Major			Medium		
					H	M	T	H	M	T
District	**Village**	**198**	**175**	**126**	**53**	**65**	**80**	**50**	**59**	**66**
Warangal	**Ranga puram**	15	0	0	0	0	15	0	0	0
	neredupalli	10	0	0	10	0	0	0	0	0
	Kummara Palli	14	0	0	0	14	0	0	0	0

Mahaboob-nagar	**Kummara Palli**	1	0	0	0	1	0	0	0	0
	Ajjakal	0	13	0	0	0	0	0	0	13
	Madanapur	0	12	0	0	0	0	0	12	0
	Sankarapeta	0	10	0	0	0	0	10	0	0
Karimnagar	**Pathi Paka**	10	0	0	10	0	0	0	0	0
	Manthani	15	0	0	0	0	15	0	0	0
	Pedda pally	15	0	0	4	11	0	0	0	0
	Devaram palli	0	10	0	0	0	0	10	0	0
	Reyula Gudem	0	12	0	0	0	0	0	12	0
	Ganga varam	0	13	0	0	0	0	0	0	13
	Mallapur	9	0	0	0	0	9	0	0	0
	Muthuampeta	6	0	0	0	5	1	0	0	0
	Venpet	5	0	0	5	0	0	0	0	0
Kurnool	**Sankarapeta**	0	1	0	0	0	0	0	0	1
	Errabadu	0	12	0	0	0	0	0	12	0
	Krishna Puram	0	10	0	0	0	0	10	0	0
	Manne Kunta	0	11	0	0	0	0	0	0	11
Nellore	**Vengva peta**	0	1	0	0	0	0	0	1	0
	Golla Palli	0	10	0	0	0	0	10	0	0
	Kancheruvu	0	11	0	0	0	0	0	10	1
	Manne Kunta	0	1	0	0	0	0	0	0	1
	Boyamadugula	0	13	0	0	0	0	0	0	13
Anantapuram	**Gonabavi**	0	10	0	0	0	0	10	0	0
	Kalugodu	0	12	0	0	0	0	0	12	0
	Kothapalli	0	13	0	0	0	0	0	0	13
Krishna	**Polisetti padu**	15	0	0	0	15	0	0	0	0
	G Kotturu	15	0	0	0	0	15	0	0	0
	Jaggaih peta	15	0	0	0	0	15	0	0	0
	Vallanpatta	9	0	0	9	0	0	0	0	0
Khammam	**Nachepalli**	15	0	0	0	15	0	0	0	0
	Laxmipuram	10	0	0	10	0	0	0	0	0
Cuddapah (Kadapa)	**Pincha**	0	0	16	0	0	0	0	0	0
West Godavari	**T.C.Rayadu palem**	0	0	3	0	0	0	0	0	0
	Setti vari guden	0	0	8	0	0	0	0	0	0

	Verra Kunia Palli	0	0	1	0	0	0	0	0	0
	Ranga puram	0	0	1	0	0	0	0	0	0
	Assana Gudem	0	0	1	0	0	0	0	0	0
	Gokavaram	0	0	1	0	0	0	0	0	0
	Yerra gunta Palli	0	0	1	0	0	0	0	0	0
Ranga Reddy	**Mahammada Bad**	0	0	15	0	0	0	0	0	0
Prakasham	**Al uru**	0	0	16	0	0	0	0	0	0
Adilabad	**Vengva peta**	0	0	11	0	0	0	0	0	0
	Al uru	0	0	5	0	0	0	0	0	0
Chittoor	**Kahipakam**	0	0	16	0	0	0	0	0	0
Medak	**Papana peta**	0	0	15	0	0	0	0	0	0
Nizamabad	**Vadluru Yelareddy**	0	0	16	0	0	0	0	0	0
Nalgonda	**Mukunda Puram**	4	0	0	4	0	0	0	0	0
	Natapure	5	0	0	1	4	0	0	0	0
	Balem Palli	10	0	0	0	0	10	0	0	0
Goa		**Project Type**								
		Major	**Medium**	**Minor**	**Major**		**Medium**			
					M	**T**	**H**	**M**	**T**	
District	**Village**	76	118	72	1	75	1	13	104	
Goa	**Karmani**	0	0	19	0	0	0	0	0	
	Betki	0	1	16	0	0	0	0	1	
	Babuli wado	0	0	2	0	0	0	0	0	
	Bhoma	0	0	1	0	0	0	0	0	
	Veling	0	0	2	0	0	0	0	0	
	Banastarim	0	0	3	0	0	0	0	0	
	Veroda	20	0	0	0	20	0	0	0	
	Talwada	6	0	0	1	5	0	0	0	
	Pairabandh	23	0	0	0	23	0	0	0	
	Ambaulim	17	0	0	0	17	0	0	0	
	Pazar cani	10	0	0	0	10	0	0	0	
	Ravana keri	0	45	0	0	0	0	2	43	
	Paryam	0	6	0	0	0	0	0	6	

	Ghoteli	0	9	0	0	0	0	0	9	
	Kudachisem	0	10	0	0	0	0	7	3	
	Gullem	0	13	0	0	0	0	2	11	
	Morelem	0	11	0	0	0	0	2	9	
	Khotode	0	1	6	0	0	1	0	0	
	Brama karmali	0	1	2	0	0	0	0	1	
	Vante	0	0	18	0	0	0	0	0	
	Ponsule	0	20	0	0	0	0	0	20	
	Androi	0	0	3	0	0	0	0	0	
	Kasarwada	0	1	0	0	0	0	0	1	
KARNATAKA		**Project Type**								
		Major	**Medium**	**Minor**	**Major**			**Medium**		
					A5 Location in the distributory			**A5 Location in the distributory**		
					H	**M**	**T**	**H**	**M**	**T**
District	**Village**	200	155	146	71	68	61	23	85	47
Belagaum	**Kulloli**	29	0	0	0	29	0	0	0	0
	Vaderahatt	25	0	0	0	1	24	0	0	0
	Rullagudi	4	0	0	0	0	4	0	0	0
	Falgaddi	2	0	0	0	0	2	0	0	0
	Kurubatti	17	0	0	17	0	0	0	0	0
	Kurabarahatti	6	0	0	6	0	0	0	0	0
	Kerukalli	1	0	0	0	1	0	0	0	0
	Arabavi	16	0	0	0	0	16	0	0	0
Bijapur	**Nagatan**	0	0	12	0	0	0	0	0	0
Haveri	**Hanagal**	0	0	12	0	0	0	0	0	0
Mysore	**Hergalli**	0	0	5	0	0	0	0	0	0
	Kannenahatti K	0	0	5	0	0	0	0	0	0
	Hubaragalli	0	0	2	0	0	0	0	0	0
Bagalakote	**Kaladgi**	0	0	7	0	0	0	0	0	0
	Ankali	0	0	3	0	0	0	0	0	0
	Kalasakoopa	0	0	1	0	0	0	0	0	0
	Sharadhala	0	0	1	0	0	0	0	0	0

Darwad	**Ambli Koppa**	0	0	6	0	0	0	0	0	0
	Holthi Koti	0	0	6	0	0	0	0	0	0
Gadag	**Majur**	0	0	12	0	0	0	0	0	0
Chithra durga	**Raganathapura**	23	0	0	1	13	9	0	0	0
	Doddagatha	15	0	0	7	7	1	0	0	0
	Pitali	13	0	0	7	4	2	0	0	0
	Aadivala Form	15	0	0	11	3	1	0	0	0
	Patrehalli form	34	0	0	22	10	2	0	0	0
Mandya	**Mallenahalli**	0	0	6	0	0	0	0	0	0
	Papana peta	0	0	1	0	0	0	0	0	0
	Bebi	0	0	6	0	0	0	0	0	0
Shimoga	**Isoor**	0	23	0	0	0	0	5	10	8
	Goma	0	6	0	0	0	0	1	2	3
	Kalmane	0	6	0	0	0	0	3	3	0
	Anjinapura	0	4	0	0	0	0	4	0	0
	Arasinagere	0	1	0	0	0	0	1	0	0
North canara	**Ramapura**	0	0	13	0	0	0	0	0	0
Bidar	**Danur**	0	9	0	0	0	0	5	3	1
	Hallkadik	0	11	0	0	0	0	1	5	5
Gulbarga	**Gobbyralbaddy**	0	2	0	0	0	0	0	0	2
	Goberwadi	0	9	0	0	0	0	1	5	3
	Danur	0	1	0	0	0	0	0	1	0
	Pattawada	0	7	0	0	0	0	0	5	2
	Hallkadik	0	1	0	0	0	0	0	1	0
Hassan	**Chakenahalli**	0	0	3	0	0	0	0	0	0
	Hariharapura	0	0	6	0	0	0	0	0	0
	Harekall	0	0	3	0	0	0	0	0	0
Ballary	**Malavi**	0	10	0	0	0	0	0	10	0
	Chitrapali	0	5	0	0	0	0	0	5	0
	Bahalli, St colony	0	1	0	0	0	0	0	0	1
	BG Halli	0	7	0	0	0	0	0	0	7
	Kalmane	0	1	0	0	0	0	0	0	1
	Bachagondana Halli	0	16	0	0	0	0	0	2	14

Rayachuru	**Katagallu**	0	12	0	0	0	0	0	12	0
	Mudabal	0	8	0	0	0	0	2	6	0
	Maraladinni	0	2	0	0	0	0	0	2	0
	Maraludinne	0	2	0	0	0	0	0	2	0
	Malavi	0	3	0	0	0	0	0	3	0
	Katagal	0	7	0	0	0	0	0	7	0
	Kattambella	0	1	0	0	0	0	0	1	0
Chikkaballapur	**Doddagatha**	0	0	1	0	0	0	0	0	0
	Pashettihalli	0	0	4	0	0	0	0	0	0
	Bannamanahalli	0	0	4	0	0	0	0	0	0
	Balaguntahalli	0	0	1	0	0	0	0	0	0
	Gurukulanaganahalli	0	0	2	0	0	0	0	0	0
Tumkur	**Kattambella**	0	0	11	0	0	0	0	0	0
	Basavanathanahalli	0	0	1	0	0	0	0	0	0
Bangalore Rural	**Soinnenahalli**	0	0	12	0	0	0	0	0	0

KERALA		**Project Type**								
		Major	**Medium**	**Minor**	**Major**			**Medium**		
					H	**M**	**T**	**H**	**M**	**T**
District	**Village**	233	152	115	13	108	112	34	48	70
Trissur	**Cheranalloor**	0	5	0	0	0	0	0	0	5
	Mundathikode	0	9	0	0	0	0	0	6	3
	Thekkumkara	0	13	0	0	0	0	12	1	0
	Panagattukkara	0	1	0	0	0	0	0	1	0
	Kallamppara	0	2	0	0	0	0	0	0	2
	Eranaloor	0	1	0	0	0	0	1	0	0
	Mudathouda	0	2	0	0	0	0	0	2	0
	Perigandoor	0	1	0	0	0	0	0	1	0
	Velathooru	0	0	4	0	0	0	0	0	0
	Parakkad	0	0	12	0	0	0	0	0	0
	Pantalam	0	1	0	0	0	0	0	1	0

	Punjadan	0	7	0	0	0	0	2	5	0
	Paloor	0	6	0	0	0	0	0	1	5
	Kallimangalam	0	15	0	0	0	0	0	6	9
	Panjal	0	6	0	0	0	0	0	6	0
	Purakulam	0	2	0	0	0	0	0	0	2
Palakkad	**Kallamppara**	0	1	0	0	0	0	0	0	1
	Elappally	0	27	0	0	0	0	4	10	13
	Marutharoade	0	10	0	0	0	0	0	0	10
	Aalapally	0	1	0	0	0	0	1	0	0
	Kodumba	0	1	0	0	0	0	0	0	1
	Parakkad	0	2	0	0	0	0	0	1	1
	Vandazhi	0	10	0	0	0	0	4	3	3
	Kavasarey	0	10	0	0	0	0	5	0	5
	Padur	0	9	0	0	0	0	3	2	4
	Malarkode	0	5	0	0	0	0	2	1	2
	Mudapaloor	0	5	0	0	0	0	0	1	4
Kozhikode	**Kutti katturoor**	0	0	4	0	0	0	0	0	0
	Poollakodi	0	0	8	0	0	0	0	0	0
	Chelavour	0	0	3	0	0	0	0	0	0
	Keezariyoor	15	0	0	6	4	5	0	0	0
	Ariculam	30	0	0	2	14	14	0	0	0
	Perabura	1	0	0	0	1	0	0	0	0
	Cheravanoor	51	0	0	0	26	25	0	0	0
	Aavla	1	0	0	0	1	0	0	0	0
	Muyippoth	2	0	0	0	0	2	0	0	0
	Edakayil	1	0	0	0	1	0	0	0	0
Ernakulam	**Mattoor**	13	0	0	2	0	11	0	0	0
	Kalady	2	0	0	0	0	2	0	0	0
	Ramamangalam	15	0	0	0	11	4	0	0	0
	Aikuranand	30	0	0	0	20	10	0	0	0
	Mazha vannoor	1	0	0	0	1	0	0	0	0
	Kuvappadi	14	0	0	1	11	2	0	0	0
	Chelamattoor	1	0	0	0	1	0	0	0	0
	Valakam	6	0	0	0	0	6	0	0	0

	Mulavoor	7	0	0	0	5	2	0	0	0
	Vengoor	2	0	0	1	1	0	0	0	0
	Raya Mangalam	1	0	0	1	0	0	0	0	0
	Vazhakulam	39	0	0	0	10	29	0	0	0
	Eimurry	1	0	0	0	1	0	0	0	0
Kannur	**Valkkara**	0	0	15	0	0	0	0	0	0
Pattanamthitta	**Pantalam**	0	0	15	0	0	0	0	0	0
Kollam	**Sooranadu**	0	0	15	0	0	0	0	0	0
Vayanadu	**Noolpuzha**	0	0	14	0	0	0	0	0	0
	Kuppadi	0	0	1	0	0	0	0	0	0
Malapuram	**Arikode**	0	0	15	0	0	0	0	0	0
	Keezapuramby	0	0	9	0	0	0	0	0	0

MAHARASTRA		**Project Type**								
		Major	**Medium**	**Minor**	**Major**			**Medium**		
					H	**M**	**T**	**H**	**M**	**T**
District	**Village**	200	136	118	105	49	46	6	127	3
Solapur	**Shirwal**	0	0	16	0	0	0	0	0	0
	Bjirolwadi	0	0	14	0	0	0	0	0	0
	Bhuvera	0	0	1	0	0	0	0	0	0
Avardha	**Shir Kunti**	0	4	4	0	0	0	0	4	0
	Non bardi	0	4	1	0	0	0	0	4	0
	Dhanali	0	2	4	0	0	0	0	2	0
	Junona	1	0	0	1	0	0	0	0	0
	Mandapur	3	0	0	3	0	0	0	0	0
	Talgaon	1	0	0	1	0	0	0	0	0
	Devagoan	1	0	0	1	0	0	0	0	0
Raigad	**Pabhare**	0	0	14	0	0	0	0	0	0
	Shir Kunti	0	0	1	0	0	0	0	0	0
	Rotidas wadi	0	0	4	0	0	0	0	0	0
	Pangari	0	0	6	0	0	0	0	0	0
	Khinda Wadi	0	0	2	0	0	0	0	0	0

	Rawat wadi	0	0	3	0	0	0	0	0	0
	Mandapur	0	0	1	0	0	0	0	0	0
Walkad	**Pabhare**	0	0	1	0	0	0	0	0	0
	Shir Kunti	10	0	0	10	0	0	0	0	0
	Dhanali	2	0	0	2	0	0	0	0	0
	Mandapur	20	0	0	20	0	0	0	0	0
	Talgaon	8	0	0	8	0	0	0	0	0
	Devagoan	3	0	0	3	0	0	0	0	0
Ahmnagar	**Jachakwadi**	0	14	0	0	0	0	0	14	0
	Rajanda	0	1	0	0	0	0	0	1	0
Akola	**Rajanda**	0	10	0	0	0	0	0	10	0
	Sindh khed	0	12	0	0	0	0	0	12	0
Amrawadi	**Devagoan**	15	0	0	15	0	0	0	0	0
	Baslapur	10	0	0	2	8	0	0	0	0
	Manjar Khed	6	0	0	0	6	0	0	0	0
	Jawka	10	0	0	10	0	0	0	0	0
	Wadhana	1	0	0	1	0	0	0	0	0
	Jalakapur	14	0	0	14	0	0	0	0	0
Hingoli	**Wakari**	0	0	27	0	0	0	0	0	0
Prabavi	**Hiwra**	0	0	3	0	0	0	0	0	0
	Roopla	0	0	2	0	0	0	0	0	0
Bhuldhana	**Devagoan**	0	0	1	0	0	0	0	0	0
	Arha	0	0	4	0	0	0	0	0	0
	Malegoe	0	0	3	0	0	0	0	0	0
	Urha	0	0	5	0	0	0	0	0	0
	Aland	0	0	1	0	0	0	0	0	0
Satara	**Jachakwadi**	1	0	0	0	1	0	0	0	0
	Bhuldev	1	0	0	0	1	0	0	0	0
	Vithani	13	0	0	6	4	3	0	0	0
	Dhulvet	22	0	0	4	18	0	0	0	0
	Algadawadi	22	0	0	3	5	14	0	0	0
	Songaon	16	0	0	1	5	10	0	0	0
	Sared	20	0	0	0	1	19	0	0	0

Sangali	**Basappa wadi**	0	13	0	0	0	0	5	8	0
	Ankale	0	3	0	0	0	0	0	3	0
	Kokli	0	13	0	0	0	0	0	11	2
	Kawadhe mahalkal	0	1	0	0	0	0	0	1	0
Mashik	**Dhanali**	0	2	0	0	0	0	0	2	0
	Ozar	0	8	0	0	0	0	0	7	1
	Janoli	0	17	0	0	0	0	1	16	0
	Mohadi	0	3	0	0	0	0	0	3	0
Rathna Giri	**Jachakwadi**	0	4	0	0	0	0	0	4	0
	Bharne	0	25	0	0	0	0	0	25	0
PONDICHERRY										
District	**Village**	168								
Puducherry	**Abishekapakkam**	20								
	Arranganur	17								
	Bahoor	19								
	Karikalampakkam	15								
	Kirumampakkam	15								
	Korkadu	18								
	Palayam	15								
	Pillayar Kuppam	15								
	Selliamedu	15								
	T N Palayam	19								

TAMILNADU		**Project Type**								
		Major	**Medium**	**Minor**	**Major**			**Medium**		
					H	**M**	**T**	**H**	**M**	**T**
District	**Village**	170	130	159	58	59	53	95	30	5
Aruyalur	**Irgagayur**	0	29	0	0	0	0	29	0	0
	Karaikurichi	0	28	0	0	0	0	0	23	5

	Sripuranthan	0	30	0	0	0	0	30	0	0
Erode	**Kauvandachipalayam**	29	0	0	0	29	0	0	0	0
	Puthurpuduplayam	29	0	0	29	0	0	0	0	0
	Thindal	28	0	0	1	3	24	0	0	0
Nellai	**Muthuottanmozhi**	0	0	25	0	0	0	0	0	0
	Rathapuram	0	0	24	0	0	0	0	0	0
Salem	**Idapatti**	0	0	30	0	0	0	0	0	0
	Pappanaickenpatti	0	0	29	0	0	0	0	0	0
	Thumbal	0	0	25	0	0	0	0	0	0
Thiruchirapalli	**Mohavanur**	0	30	0	0	0	0	30	0	0
	Palayakottai	0	5	0	0	0	0	5	0	0
	Sekkanam	0	8	0	0	0	0	1	7	0
Thiruvanmalai	**Chellankuppam**	29	0	0	0	0	29	0	0	0
	Kadiayankuppam	27	0	0	27	0	0	0	0	0
	Velyambakkam	28	0	0	1	27	0	0	0	0
Virudhunagar	**Thevathanam**	0	0	26	0	0	0	0	0	0

3.3 Selection of Minor Irrigation

Minor irrigation projects were selected from districts other than those covered in the major and medium projects. This was done to give a wider representation to the districts in the states. Extensive discussions were held with the Directorate of Minor Irrigation in respective states and the officials associated with minor irrigation projects in the state. The list of minor irrigation project villages selected in each state is provided in Table 3.3.

Table 3.3: List Minor of Irrigation Project Villages

	District	Village	Farmers
1	**ANDHRA PRADESH**		
	Kadapa	Pincha	16
	West godavari	T.C.Rayadu palem	3
		Setti vari guden	8
		Verra Kunia Palli	1
		Ranga puram	1

		Assana Gudem	1
		Gokavaram	1
		Yerra gunta Palli	1
	Ranga reddy	Mahammada Bad	15
	Prakasham	Al uru	16
	Adilabad	Vengva peta	11
		Al uru	5
	Chittoor	Kahipakam	16
	Medak	Papana peta	15
	Nizamabad	Vadluru Yelareddy	16
2	**Goa**		
	Goa	Karmani	19
		Betki	16
		Babuli wado	2
		Bhoma	1
		Veling	2
		Banastarim	3
		Khotode	6
		Brama karmali	2
		Vante	18
		Androi	3
3	**KARNATAKA**		
	Bijapur	Nagatan	12
	Haveri	Hanagal	12
	Mysore	Hergalli	5
		Kannenahatti K	5
		Hubaragalli	2
	Bagalakote	Kaladgi	7
		Ankali	3
		Kalasakoopa	1
		Sharadhala	1
	Dharwad	Ambli Koppa	6
		Holthi Koti	6

	Gadag	Majur	12
	Mandya	Mallenahalli	6
		Papana peta	1
		Bebi	6
	North canara	Ramapura	13
	Hassan	Chakenahalli	3
		Hariharapura	6
		Harekall	3
	Chikka ballapur	Doddagatha	1
		Pashetti Halli	4
		Bannamana Halli	4
		Balagunta Halli	1
		Gurukulanagana Halli	2
	Tumkur	Kattambella	11
		Basavanathanahalli	1
	Bangalore rural	Soinnena Halli	12
4	**KERALA**		
	Trissur	Velathooru	4
		Parakkad	12
	Kozhikode	Kutti katturoor	4
		Poollakodi	8
		Chelavour	3
	Kannur	Valkkara	15
	Pattanamthitta	Pantalam	15
	Kollam	Sooranadu	15
	Vayanadu	Noolpuzha	14
		Kuppadi	1
	Malapuram	Arikode	15
		Keezapuramby	9
5	**MAHARASTRA**		
	Solapur	Shirwal	16
		Bjirolwadi	14
		Bhuvera	1

	Avardha	Shir Kunti	4
		Non bardi	1
		Dhanali	4
	Raigad	Pabhare	14
		Shir Kunti	1
		Rotidas wadi	4
		Pangari	6
		Khinda Wadi	2
		Rawat wadi	3
		Mandapur	1
	Walkad	Pabhare	1
	Hingoli	Wakari	27
	Prabavi	Hiwra	3
		Roopla	2
	Bhuldhana	Devagoan	1
		Arha	4
		Malegoe	3
		Urha	5
		Aland	1
6	**PONDICHERY**		
	Puducherry	Abishekapakkam	20
		Arranganur	17
		Bahoor	19
		Karikalampakkam	15
		Kirumampakkam	15
		Korkadu	18
		Palayam	15
		Pillayar Kuppam	15
		Selliamedu	15
		T N Palayam	19
7	**TAMILNADU**		
	Nellai	Muthuottanmozhi	25
		Rathapuram	24
	Salem	Idapatti	30

		Pappanaickenpatti	29
		Thumbal	25
	Virudhunagar	Thevathanam	26

3.4 Field Surveys

Three agencies were engaged for primary data collection. The agencies were chosen based on their expertise in collection of primary data. They were appropriately briefed about the project. The Nodal Officers in all the States provided excellent logistical and overall support to the field staff to enable them to interact with the farmers and collect the data. This primary data collection was completed in a record time of 2 months from about 3500 farmers across 68 Districts covering 5 major and other 5 union territories.

District wise analysis of the primary data along with secondary data received from the respective states is discussed in subsequent chapters.

3.5 Participatory Rapid Appraisal (PRA) workshops

In order to make up for the data gaps, referred to earlier, the study team conducted three PRAs at Bangalore, Hyderabad and Tirsur to elicit the opinion of the officials from Irrigation, Revenue, and Agriculture Departments as also from officers of Bureau of Economics and Statistics. Representatives of water user's association were also invited to ascertain the problems of tail end farmers, maintenance issues and water rates. Details are presented in chapter 10 of the report. The schedule used for PRA exercise is provided in Annexure 4.

CHAPTER 4

ANDHRA PRADESH

CHAPTER 4
ANDHRA PRADESH

4.0 Current irrigation scenario: The Problem of Gap Ayacut

Andhra Pradesh comprises of three regions namely (i) Coastal Andhra (ii) Rayalaseema and (iii) Telangana. For administrative convenience, it is divided into 23 districts, comprising of 1128 mandals. Andhra Pradesh has a population of 7.23 Crores. About 73% of the people live in rural areas, of which, 65% derive their livelihood from agriculture.

Land use in Andhra Pradesh is as follows:

Geographical area	678.28 Lakh Acres
Forest area	152.43 Lakh Acres
Cultivable area	389.72 Lakh Acres
Sown area	260.13 Lakh Acres
Irrigated area	128.81 Lakh Acres

4.1 Water Resources:

Andhra Pradesh State is blessed with 40 rivers, major among them being Godavari, Krishna, Pennar, Vamsadhara and Nagavali. The net dependable yield from all these 40 rivers is 2764 TMC. On an average, every year about 4000 TMC of water surpluses into sea, from all these 40 rivers and from Godavari alone about 3000 TMC flows into sea. Water utilization from all the existing projects is only 1760 TMC, till 2004. The annual average rainfall varies from 550 mm to 1300 mm.

4.2 Drought:

Even the major perennial rivers are highly seasonal. More than 90% of total flows occur between June and December and rainfall varies greatly from year to year. As a result most of the mandals are declared drought hit, as shown in the following table 4.1

Table: 4.1 Droughts: The Problem of Water Scarcity

	1997-98	1999-00	2001-02	2002-03	2003-04	2004-05
Mandals affected	920	68	995	1041	453	813

- Total No. of Mandals in AP: 1128
- Total Loss in 2002–03: Rs 5277 crores
- Agricultural crop losses: 47.75 Lakh Acres

4.3 Need For More Storage Reservoirs

Therefore, construction of storage reservoirs is a prerequisite to sustain Irrigation development. The Krishna water Dispute Tribual (Bachawat Award in 1975) permitted Andhra Pradesh to utilize the surplus water. But every time Andhra Pradesh sent proposals to CWC for construction of storage reservoirs, neighbouring states objected and CWC hesitated to accord the required clearances, citing Inter-State objections. How the surplus water can be utilized, without construction of storage reservoirs is the big controversy between the States involved and now a second tribunal headed by Justice Brijesh Kumar (2004) is set up to look into the matter.

4.4 Jalayagnam: 2004

In 2004, Govt. of Andhra Pradesh took up a massive construction programme of Irrigation projects, under the caption “Jalayagnam”. 30 major irrigation projects & 18 medium Irrigation projects, estimated to cost about Rs. 46000 crores, were taken up for execution. With a view to completing those in a fixed time frame of 2 to 5 years, works were awarded on the EPC – Turn key system of contracts. Some of these projects have already been completed and the expectation is that others will be completed by Khariff 2008. Govt. of Andhra Pradesh now has revised plans to augment investment to Rs.one lakh crores in Jalayagnam and, thereby, create additional Irrigation Potential of one crore acres by 2010.

Jalayagnam has faced two sets of criticisms. The first was political. "Sreeyamsi Bahu Vighnani". The launch of the project was politicized. Questions were asked about the availability of water, source of money for the project, clearances from the Central government, availability of staff in the irrigation department to carry out the task and so on. But the State Government, marched ahead, undaunted by all this criticism. Some journalists moved the High Court on implementing the EPC – Turn Key system of contracts for speedy execution of Contracts and when they lost their cases in High Court, they even approached Supreme Court and again lost. The net impact was that implementation of 'Jalayagnam' got delayed by about one year.

A second criticism was more technical. Some technical experts expressed apprehensions about the need to construct new irrigation projects, before trying to address the wide gap that currently existed between irrigation potential created and utilized in the existing projects.

While there is no question about the need to increase irrigation water supplies in course of time, through new investments, there is also considerable merit in the argument that unless the reasons for the gap between potential created and utilized in the existing irrigation projects are properly understood the new projects may fall prey to same problems and thus the full potential from new projects may not be realized.

The above point assumes particular importance in the context of the present study. In what follows, we address some of these issues.

4.5 Gap between Potential Created and Utilized: General Reasons

The gap between irrigation potential created and utilized is a national problem and not just confined to Andhra Pradesh. As brought out in Chapter 1, this gap on an all India basis is not only there but also widening over the plan periods albeit more in the case of major than medium/small irrigation projects. We begin with a general view of why such gap exists.

Variations in Statistics reported:

Under every project, the Irrigation Potential created and utilized is reported differently by different departments. The Irrigation Department goes by water released and estimates the ayacut. The Revenue Department goes by water cess collected. The Agriculture Department goes by the area in which crops are raised.

Further, in figures computed by Irrigation Department, the pilferages are not taken into account. It is a common sight for anyone walking through the Irrigation canals & distributaries that thousands of Siphons & pumps operate to pilfer water. Irrigation department is not equipped with sufficient staff or with powers to stop it. They show it under the head 'System Losses'.

The Revenue department goes by the previous records of localization orders issued earlier and it does not update them whenever new ayacut is added.

To put an end to this controversy, Andhra Pradesh has made an attempt to rope in the Services of satellite remote survey agencies. A comparative statement for 2006-07 in respect of 12 major projects is appended as Appendix 'A'. However, variations still remain.

Technical Reasons:

It is not possible to create Irrigation Potential in one agriculture season for the entire command area of a project, due to land acquisition problem and funds flow problem. Thus the tail-enders of the ayacut receives water with a lag of at least one or two seasons. Meanwhile the ayacutdars in head reaches go for wet crops, though a particular project is designed for I.D. crops only. Once they raise wet crops, because of availability of abundant water, they refuse to go for dry crops, in the next seasons. This is further aggravated by a) absence of measuring devices and control structures, b) lack of incentives for saving water, and, c) poor drainage facility.

Again, periodical silt removal and weed removal is a pre-requisite for smooth flow of water till tail end in canals. More than 35 types of water weeds are identified by the Agriculture College, Bapatla, in the Irrigation Canals of Andhra Pradesh. There is no single cure for all of them. A variety of methods are being used, depending on the weeds noticed in different areas. No single method is found to be effective and, therefore, more often, more than two methods are used to get rid of these water weeds. These methods are: a) Manual Removal: This is resorted to clear the weeds from the vents of bridges and other cross drainage structures. However, several cases of lower level staff, putting up inflated bills have come up and therefore Government directed in 1996, that this should be resorted to only after a personal inspection of Senior Officers. This resulted in inaction, b) Mechanical Removal: When the canal is dried up poclains are used to remove the silt as well as weeds from the canals and the drains. In the delta areas, where the weed growth rate is very high & where the canals flow for about 10 months in a year, dredging through amphibious cutter / dredgers are deployed. Dredgers are also deployed to clear the seam mouth areas of drains, which get closed by sand casting due to tidal wave effect of sea, particularly in non-monsoon periods c) Chemical Spraying: Certain chemicals are being used for water weed control. However, these chemicals are believed to be more helpful for mango crops. Complaints of diversion of chemicals with the connivance of staff have stopped it. Developed countries have also prohibited use of Chemicals, keeping in view the need to maintain good environment and, d) Biological Control: The Central Pest Management Research Institute has developed species of insects (Neo-Chetina and Neo-Chetina Bruchi), which eat up a particular specie of water weed and help in the prevention of weed growth.

Economic Reasons:

The Government has been somewhat stingy in release of annual budget for O & M of major projects. This 'penny-wise, pound-foolish approach has not only impacted the efficiency of irrigation projects causing indirect loss by way of less crop output, but has also resulted in massive expenses for repairs to make up for the long neglect of these projects.

Social & Political Reasons:

A spirit of cooperation between the adjoining villages, mandals & districts, when it comes to release of water leaves much to be desired. In the N.S. Right Canal water releases, for example, cases of disputes between the farmers of Guntur & Prakasam Districts are reported. Similarly, in the SRSP Command Area, there are reports of water wars between Karimnagar and Warangal Districts.

Minor disputes, which can be sorted out at village level are blown out of proportion, if the political leadership in the villages involved in the dispute, belong to different political parties. Most of them are not interested in common good of the people; they are interested in making the dispute a stepping stone for their self promotion. A small dispute may thus end up as a war between two mandals or districts.

Minor Irrigation:

Generally the management of minor tank irrigation schemes is better due to involvement of farmers. However, maintenance, which is to be carried out by the I & CAD Department, is usually deficient, thus resulting in losses and decline of irrigated areas. In addition, overall performance of most minor irrigation tanks is more sensitive to droughts and cyclones due to small size. Yet, it may be said that they are the life line to the village communities. There were as many as 12,294 tanks under I & CAD Department covering 1.25 M ha. in 27,379 villages as per the survey conducted by AFC in 1998. Unfortunately, these have come down to only 9600 by 2004. Reason is development. Whenever, the Government announces a development programme, say Housing, Schools, Bus Depots, Small & Cottage Industries, The District Revenue Authorities assign the catchment areas of MI tanks and in some cases, they even allot the bed of a tank. Added to the misery are the real estate agencies, which encroach the MI tanks in the vicinity of cities and towns & build up satellite towns.

4.6 Attempts made by the State to Reduce the Gap:

To start with, the AP government adopted the Dublin principles. Four simple, yet powerful messages were provided in 1992 in Dublin. These are:

1. Fresh water is a finite & vulnerable resource, essential to sustain life, development & the environment.

2. Water development and management should be based on a participatory approach, involving users, planners and policy –makers at all levels.

3. Women play a central role in the provision, management & safeguarding of water

4. Water has an economic value in all its competing uses and should be recognized as a economic good.

In April 1997, the Government of Andhra Pradesh introduced the "**PARTICIPATORY IRRIGATION MANAGEMENT ACT".** The proposal under this Act was that water users themselves would operate & maintain the water conductor systems in their areas, thus reducing dependence on government departments. It provides for a three-tier body viz., Project committee, Distributory Committee and Water Users Association (WUA). In all the three committees the members were to be elected the water users. In June 1997, 10,292 WUAs were constituted, covering entire surface area of about 4.90 million hectares. In November 1997, 197 Distributory committees were constituted. The Act was amended in 2005 & elections were held for the second term. However, project committees are yet to be constituted. Also, the stipulation under the Act that farmers, besides operation and maintenance of water conductor system, would also collect revenues did not materialize.

The irrigation potential created up to the year 1997 in Andhra Pradesh under major, medium and minor irrigation was 4.80 million hectares. Out of this only 2.84 million hectares is being irrigated, thereby, leaving a gap of 1.96 million hectares. Clearly, this suggests a very low level of efficiency. In order to remedy the situation, Andhra Pradesh government included irrigation rehabilitation & maintenance, as a component of multi – sectoral APERP, funded by World Bank. Details are listed in Table 4.3.

Table 4.2 Details of World Bank-funded Projects

	Funding	**Rs.In Millions & Ayacut in M.Ha**	
Sl. No	**Component**	**Cost**	**Ayacut Covered**
1	SPI (Scheme Performance Improvement)		
	a) Minimum Rehabilitation (MR)		
	---- Major (10 Projects)	5416	2.17
	---- Medium (63 Projects)	707	0.28
	---- Minor (2934 Projects)	1655	0.37
		7778	**2.82**
	b) Recurrent Maintenance (RM)		
	---- Major (10 Projects)	2873	2.17
	---- Medium (63 Projects)	172	0.28
	---- Minor (12,294 Projects)	1697	1.25
		4742	**3.70**
2	Scheme Improvement & Farmers Turn Over (SIFT)	697	0.05
	Total	**13217**	**6.57**

The post project implementation study of APERP (1998 to 2004), done by M/s. Q Engineering Prospects Pvt. Ltd commented that the APERP was launched at an opportune time when favourable political, administrative & public environment, created by economic reforms in the country & sectoral reforms in the state in particular like APFMIS Act 1997, were in place. The post project evaluation also noted that project implementation was realistic and of satisfactory quality.

They reported that as a result it was possible to bridge the ayacut gap by 2.1 lakh hectares in 1998-99, by another 2 lakh hectares in 1999- 2000, thus enabling a total closure of gap

of 4.1 lakh hectares by the end of 2000-01. In 2000-01, there was not much progress due to the dry spell in the State, which dried up the reservoirs. The rise in the gap ayacut bridged was due to M.R. and O & M works and WUA activity. The table 4.4 below shows the bridging of gap ayacut, project wise:

A.P.E.R.P (I.C.)

Table 4.3 Bridging of Gap Ayacut

(Ayacut in Ha.)

Sl. No.	Name of the Project	Gap ayacut bridged in 1998-99	Gap ayacut bridged in 1999-2000	Gap ayacut bridged in 2000-2001	Total
I. Major Irrigation					
1	Vamsadhara Project	6879.81	353.70	Nil	7233.51
2	N.S. Left Canal	20234.72	16187.78	Nil	36422.5
3	N.S. Right Canal	21448.81	12140.83	Nil	33589.64
4	Tungabhadra Project H.L.C	4046.94	5261.03	Nil	9307.97
5	Tungabhadra Project L.L.C	4451.64	2023.47	Nil	6475.11
6	Rajolibanda Diversion Scheme	809.39	1011.74	Nil	1821.13
7	Nizamsagar Project	29947.39	6879.81	Nil	36827.2
8	Kadam Project	9307.97	4856.33	Nil	14164.3
9	Sriramsagar Project	101578.31	30352.08	Nil	131930.39
10	K.C. Canal	8498.58	4046.94	Nil	12545.52
	Sub Total - I	**207203.56**	**83113.71**	**Nil**	**290317.27**
II. Medium Irrigation					
a.	Coastal Andhra Region		12400.00	Nil	12400
b.	Rayalaseema Region		3500.00	Nil	3500
c.	Telangana Region		11100.00	Nil	11100
	Sub Total - II		**27000.00**	**Nil**	**27000**

III. Minor Irrigation					
a.	Coastal Andhra Region		5410.76	Nil	5410.76
b.	Rayalaseema Region		17078.11	Nil	17078.11
c.	Telangana Region		68029.14	Nil	68029.14
	Sub Total - III		**90518.01**	**Nil**	**90518.01**
	Grand Total	**207203.56**	**200631.72**	**Nil**	**407835.28**

The State Government has, nevertheless, progressively addressed the issue of the gap. In response to Ministry of Water Resources, Government of India appointing a sub-committee in October 2006 to study & recommend ways for achieving more crop & income per drop of water, the State Government took up a programme to renovate & modernize the age old irrigation systems. It issued orders vide G.O. Ms. No. 34, Dt: 09-02-2007 that under all major LI Schemes 100% ayacut is to be brought under micro irrigation. With a view to bring in more areas under irrigation, Government suggested micro irrigation in projects like GNSS.

Further, in 2007, Government took up modernization of NSP, Godavari Delta, Krishna Delta and Pennar Delta, whereby, wherever necessary, structures are to be repaired and main canals and distributaries lined. An amount of Rs. 12,912 crores is earmarked towards all the above modernization works and the work is expected to be completed by 2010-11.

In summary, it may be said that while the State Government has initiated, from time to time, a combination of measures to narrow the gap, the gap persists and is, perhaps, growing. Frequent droughts in the state may have acted as a damper in government's efforts. But, precisely in times like this, the role of the farmers' organization comes to the fore. However, WUA's have failed to rise to the occasion. Tail-end farmers have been left behind. Bringing a sense of cooperation and camaraderie in times of adversity is, indeed, a challenge, particularly when farmers are divided on caste and political lines.

4.7 Analysis of Secondary Data on Irrigation Projects

Data provided by the department for the selected projects is analyzed separately for Major, Medium and Minor Projects.

Major Irrigation:

Nagarjuna Sagar (NS)

NS provides irrigation benefits to areas in Nalgonda, Khammam, Krishna, West Godavari, Guntur and Prakasam districts

Gates were erected in 1974 and the project has been in operation since 1967. Quantity of water for irrigation is 264 TMC Number of yield realized as per project report up to 2002 is 33 years in a period of 34 years

Data on Nagarjunasagar Left Main Canal (Lal Bahadur Canal) is provided in tables 4.5 to table 4.9

Table 4.4 Details of Left Main Canal for the past 6 years

Year	Planned (as per Project Report)		Quantum supplied (TMC)
	Quantum to be supplied (TMC)	Area to be Irrigated (lakh Hectares)	
2002-03	132	4.01	22.26
2003-04	132	4.05	20.49
2004-05	132	4.09	136.31
2005-06	132	4.1	216.24
2006-07	132	4.1	222.54
2007-08	132	4.1	219.35

Reduction in the flow of water supplied during 2002-03 and 2003-04 was due to reduction in the yield

During 2002-03, irrigation supplies commenced and stopped due to low reservoir levels prevailing consequent to low inflows. During 2003-04, water was let into canals only to fill drinking water tanks. The amount of water released through the distributory was utilized for irrigation of wet crops as well as dry crops.

Table 4.5 Year wise Ayacut Development under Nagarjunasagar Left Canal

(Area in Hectares)

Year	1st crop			2nd crop			Total of the year			Water Utilised in TMC
	Wet	ID	Total	Wet	ID	Total	Wet	ID	Total	
2002-03	0.2	0	0.20	0	0.00	0.00	0.20	0.00	0.20	22.26
2003-04	0	1.83	1.83	0	3.11	3.11	0.00	4.94	4.94	20.49
2004-05	0.98	2.19	3.17	0.61	0.00	0.61	1.59	2.19	3.78	136.31
2005-06	1.74	1.78	3.52	1.45	0.18	1.63	3.19	1.96	5.15	216.24
2006-07	1.78	1.71	3.49	1.16	1.03	2.19	2.94	2.74	5.68	222.54
2007-08	1.83	1.59	3.42	1.21	0.56	1.77	3.04	2.15	5.19	219.35

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Table 4.6 Mudimanikyam Major

(Area in Lakh hectares)

Year	**Planned (as per Project Report)**		**Actual Utilisation**	
	Quantum to be supplied (TMC)	**Area to be Irrigated**	**Quantum supplied (TMC)**	**Area Irrigated**
2	3	4	5	6
2002-03	4.61	0.1035	1.33	0.029
2003-04	4.61	0.1035	Water not released	
2004-05	4.61	0.1035	4.79	0.0824
2005-06	4.61	0.1035	4.07	0.1035
2006-07	4.61	0.1035	3.38	0.1035

Table 4.7 Mangapuram Major

(Area in Lakh hectares)

Year	**Planned (as per Project Report)**		**Actual Utilisation**	
	Quantum to be supplied (TMC)	**Area to be Irrigated**	**Quantum supplied (TMC)**	**Area Irrigated**
2	3	4	5	6
2002-03	0.0423	0.134	-	-
2003-04	0.0423	0.134	0.038	-
2004-05	0.0423	0.134	0.0265	0.10117
2005-06	0.0423	0.134	0.0538	0.11
2006-07	0.0423	0.134	0.423	0.11
2007-08	0.0423	0.134	0.0433	0.12

Table 4.8 Ganugapadu Major

(Area in Lakh hectares)

Year	Planned (as per Project Report)		Actual Utilisation	
	Quantum to be supplied (TMC)	Area to be Irrigated	Quantum supplied (TMC)	Area Irrigated
2	3	4	5	6
2002-03	0.0045	0.03	-	-
2003-04	0.0045	0.03	0.00121	-
2004-05	0.0045	0.03	0.00345	0.027
2005-06	0.0045	0.03	0.00424	0.026
2006-07	0.0045	0.03	0.00532	0.027
2007-08	0.0045	0.03	0.00478	0.025

Reason for reduction in quantum of irrigation water supplied (TMC) is attributed to the canal problems. The difference between area to be irrigated and actual area irrigated resulted due to changes in the cropping pattern in these areas.

Medium Irrigation

1. Bhairavani Tippe (B.T)

The project was completed in 1961. The irrigation potential created was 2.622 TMC of which 2.305 TMC was allocated to irrigation of crops. Till 2002, the yield was realized 26 times out of 41 years. The records show that only in 2002-03 irrigation water to the extent of 0.783 TMC could be realized and released for kharif season to benefit 337.11 hectares of area from R.F.M.C 2C to 4B distributory. Likewise water was made available in the same year to the extent of 783 TMC during rabi season to irrigate 566.57 hectares of area under crops.

In year 2005-06, water was made available for rabi season crops to the extent of .450 TMC to irrigate 2768 hectares of area under the project. In year 2006-07, water was available during rabi season in reduced quantum. Area irrigated was only 275 hectares and water released was .114 TMC.

The above data shows that a wide gap existed between irrigation potential created and utilized between 2002-03 and 2006-07. Low rainfall was cited as the main reason for this widening of gap.

2. Sarala Sagar

Sarala Sagar was completed in 1956. Out of 1.372 TMC irrigation potential created, 0.491 TMC was meant for irrigation of crops. 25 times out of 49 years the yield of water was realized till 2002.Since then the situation has worsened. For example, in 2005-06 only 0.267 TMC of water was available. Poor rainfall and canal problems were cited as reasons for this denouement in 2005-06.

3. Boggulavagu

The project was completed in 1982 and 0.596 TMC out of 0.741 TMC irrigation potential created was meant for irrigation of crops. Till 2002, 15 times out of 21 years the yield was realized. Distributory wise data is available for years 2002-03 to 2006-07. 2004-05 was drought year. In 2002-03, water was made available to irrigate 708 ha out of 708 ha (100%) through 1st distributory and only 365.56 ha out of 460 ha (80%) through 2nd distributory and no water release was possible through 3rd distributory due to wastage due to breaches and canal problems

4. Gandipalem

Gandipalem was completed in 1984 and 1.505 TMC out of 1.62 TMC irrigation potential created was meant for irrigation of crops. Till 2002, 15 times out of 19 years the yield of water was realized. Water to be supplied through left and right main canals of this project are 1.052 and 0.479 TMC respectively. During the last five years (2002-03 to 2006-07), the percentages of available water to the expected quantum of water are 4.40%, 6.8%, 8.2%, 57.9% and 57.9%, respectively. Reduction in rainfall and erosion of side slopes and collapse and blocking of waterways was given as reasons for this erratic performance. Thus, the percentage of irrigated area under crops realized was only 4 to 8 percent in first three years and 58% in last two years supported by left main canal. On

right canal side the percentage of actual area irrigated over the expected area was 40% and 61% in first two years and above 73% (73% -76%) in the subsequent years.

5. Raiwada

This project was completed in 1986 and 2.00 TMC out of 4.00 TMC irrigation potential created was meant for irrigation of crops. 1.60 TMC (GVMC) and 1.00 TMC (LRR) of water were allocated for drinking water schemes. 12 times out of 17 years the yield of water was realized till 2002. Left canal of the project has 7 distributory known as Uyyala chintagedda, Kothakalva, Mahapatruni tank. Medicherla, Varada and Rongalinaidu palem. Right canal has 6 distributory known as Pydemmapeta, & Jagadannadhapuram Revallu & Lakkavaram and Juthada & Chodavaram.

The project, through the left main canal, could supply 76-78 % of expected irrigation water over this 5 year period and enabled nearly 97-99% of area irrigated with the exception of year 2003-04. Damage to irrigation canal lining is mentioned as reason for this reduction in irrigation water supply and changes in adopted cropping pattern is the reason for reduction in area irrigated in 2003-04. Whereas the project could achieve 99% of quantum supply and area irrigated through its right canal and its distributor (Table 4.10). Revalur and Lakkavarm distributory had more damages to canal lining

Table 4.9: Raiwada Reservoir Project

Percentage of quantum of water supplied (TMC) and Area irrigated (Ha) over the expected quantum and area				
	Left Canal		**Right Canal**	
Year	**Quantum supplied (%)**	**Area irrigated (%)**	**Quantum supplied (%)**	**Area irrigated (%)**
2002-03	78.01	97.47	99.36	99.75
2003-04	76.41	92.22	98.98	99.54
2004-05	79.63	99.48	99.03	99.59
2005-06	79.60	99.45	99.03	99.54
2006-07	79.38	99.17	99.03	99.54

6. **Gajuladinne**

It was completed in 1977 and 2.00 TMC out of 3.525 TMC irrigation potential created was meant for irrigation of crops. 9 times out of 26 years the yield of water was realized till 2002.

In 2005-06, 50% of the expected quantum of water was received and around 50% of area under the project had water supply. In 2002-03, about 25% of irrigation potential created was realized. Reasons for the gaps given were a) reduction in rainfall and yield b) poor maintenance, erosion of side slopes. Salinity of soils was also mentioned as a reason for low percentage of irrigated cropped areas.

Minor Irrigation:

The ultimate potential of minor irrigation (surface and ground water) in this state is 6.26 million hectares. Till the end of IX plan, the state was able to create 5.43 million hectares of irrigation potential and provide irrigation to 3.67 million hectares of command area. The gap was thus 32% at the end of the plan period. The state's target in X plan is to create 0.43 million hectares of additional irrigation potential under minor irrigation schemes.

A detailed study by NIRD has identified about 64,000 minor irrigation tanks across the state, each having an ayacut of about 40 ha and above. About 2.6-3.0 million hectares of land can be brought additionally under assured irrigation system through these tanks according to the study findings.

There are several problems by way of utilization of tank water irrigation in the State. These are:

1. Lack of sufficient funds to carry out the annual maintenance of tanks as they come under the jurisdiction of panchayats for management. The government stipulates that Minor Irrigation Department will be entrusted with this responsibility in future.

2. Most of the tanks are spread across 22 districts; and a majority of them are in the drought-prone districts like Vizianagaram, Srikakulam, Chittoor, Mahbubnagar, Karimnagar, and Nalgonda. Successful rainfall in these reasons will be crucial to realization of the potential created for irrigation through these tanks.

A.P government plans to involve the stakeholders (farmers) in maintaining the irrigation tanks and minor irrigations projects as the community participation will help to bridge the gap between the potential created and utilization of minor irrigation projects. .

The government has decided to double its budget to Rs 880 crore for the year 2008-09, besides augmenting finances from various international funding agencies, including World Bank, worth Rs 1,044 crore.

Repair works will be taken up to restore a large number of tanks under the 'Indiramma Cheruvu' scheme with sufficient budgetary support from the State. During the last 4 years, 260 minor irrigation schemes have been completed by incurring an expenditure of Rs. 158.70 crores to benefit an ayacut of 45,850 acres. 198 minor irrigation schemes are currently under execution at a cost of Rs. 131.00 crores to benefit 64,415 acres.

4.8 Estimation of Gap between Irrigation Potential Created and Utilized in Andhra Pradesh- Results of Primary Data Survey

Data was collected, through a structured and pretested questionnaire, from a total of 500 farmers, covering Major, Medium and Minor irrigation schemes in Andhra Pradesh. To make the sample representative, to the extent possible, of the entire state, a total of 20 districts were covered under the survey. Totally 48 villages were covered across the three types of irrigation schemes. Special efforts were made, while selecting the villages, to provide adequate representation to the farmers in the head reach, mid reach and tail reach. The details of sample selected under major, medium and minor projects and comprehensive analysis of primary survey data analysis is presented in Annexure 6

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation

at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project
- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data on the above items was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers. Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach was also identified. In addition, the area under major, medium and minor irrigation schemes for the sample farmers was obtained. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 1760.50 acres. Of this area, 525.75 acres are in the head reach, 422.25 acres are in the mid reach and another 499.50 acres are in the tail reach. Similarly, 905.50 acres are under major irrigation projects, 542 acres are under medium irrigation projects and the remaining 313 acres are under minor irrigation projects (Refer Table 4.11)

Table 4.10 Details of Irrigated in sample villages

Irrigated Area - Owned						
		2006-07				
		H	M	T	Minor	Total
Category	Major	374.25	200.25	294.50		869.00
	Medium	149.50	194.50	198.00		542.00
	Minor				312.00	312.00
Total		523.75	394.75	492.50	312.00	1723.00
Irrigated Area - Leased IN						
		2006-07				
		H	M	T	Minor	Total
Category	Major	2.00	27.50	7.00		36.50
	Medium	0.00	0.00	0.00		0.00
	Minor				1.00	1.00
Total		2.00	27.50	7.00	1.00	37.50
Total Irrigated Area						
		2006-07				
		H	M	T	Minor	Total
Category	Major	376.25	227.75	301.50		905.50
	Medium	149.50	194.50	198.00		542.00
	Minor				313.00	313.00
Total		525.75	422.25	499.50	313.00	1760.50

In the year 2006-07, the gap is the highest under the medium irrigation schemes in both Kharif and Rabi seasons. While the overall gap is only 5.51 percent in Kharif season, it is more than 93 percent in the Rabi season. It is possible that the projects under study are actually meant for providing irrigation water only in the kharif season and hence it may not be relevant to calculate the gap for rabi season. At the same time it is also possible that the projects under study are meant for providing complete or partial irrigation in the rabi season in which case the gap is to be calculated in order to get the complete picture. Unfortunately, there was no information or data from the state department of irrigation and hence there the gap is calculated to provide an indication of the irrigation potential created and utilized. One of the interesting aspects of Andhra Pradesh state is that the area utilized for irrigated in the tail reaches of the major projects in kharif season is more than the irrigation potential created. It was informed to the study team that there is certain amount of un-authorized irrigation in the tail end reaches of certain projects in

Andhra Pradesh (Refer Tables 4.12 to 4.14). This was also confirmed by the members of the Water users' associations during the PRA meetings. There are no irrigated crops grown in the summer season in the study area.

Table 4.11 Area under Irrigated Crops (acres)

		2006-07				
		H	**M**	**T**	**Minor**	**Total**
A1 Project Name	Major	229.10	210.85	309.50	.	749.45
	Medium	91.75	136.50	129.30	.	357.55
	Minor	.	.	.	295.75	295.75
Total		320.85	347.35	438.80	295.75	1402.75
Rabi						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
A1 Project Name	Major	63.25	67.50	36.50	.	167.25
	Medium	0.00	13.00	21.75	.	34.75
	Minor	.	.	.	153.50	153.50
Total		63.25	80.50	58.25	153.50	355.50

Table 4.12 Gap between Irrigation Potential created and Utilized (based on data from Sample farmers)

GAP (Percentage)						
Kharif						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
A1 Project Name	Major	39.11	7.42	-2.65		17.23
	Medium	38.63	29.82	34.70		34.03
	Minor				5.51	5.51
Total		38.97	17.74	12.15	5.51	
Rabi						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
A1 Project Name	Major	83.19	70.36	87.89		81.53
	Medium	100.00	93.32	89.02		93.59
	Minor				50.96	50.96
Total		87.97	80.94	88.34	50.96	

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the

irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them.

Table 4.13 Limits of gap based on survey data analysis

Category	No of sample farmers	Kharif			Rabi			Summer		
		Gap %	Lower Limit	Upper Limit	Gap %	Lower Limit	Upper Limit	Gap %	Lower Limit	Upper Limit
Major	179	5.11	1.88	8.34	60.17	53.00	67.34	90.16	85.80	94.52
Medium	145	4.12	0.88	7.36	58.64	50.62	66.66	96.45	93.44	99.46
Minor	127	7.13	2.65	11.61	59.81	51.28	68.34	94.53	90.58	98.48
Head	77	5.35	0.32	10.38	64.96	54.30	75.62	90.79	84.33	97.25
Mid	145	6.83	2.72	10.94	61.46	53.54	69.38	94.18	90.37	97.99
Tail	102	0.77	0.00	2.47	51.25	41.55	60.95	93.48	88.69	98.27
Total	451	5.46	3.36	7.56	59.58	55.05	64.11	93.52	91.25	95.79

4.9 Summary and Conclusions

There are several learnings from this chapter. While there is no question about the presence of a gap between irrigation potential created and utilized, trying to figure out the exact size of this gap and the reasons thereof are riddled with methodological and procedural errors. First, different organizations connected with irrigated agriculture follow different methods for estimating the gap. Second, the concerned departments either do not maintain or are unwilling to part with the crucial data that is needed to address this issue, at the project level. Third, nevertheless, some common explanations for the gap have emerged from the study irrespective of the methodology used. These are a) non-cooperation of the farmers despite the setting up of Water Use Associations, b) non-adherence to cropping pattern and, c) technical problems, particularly at the canal level.

The task before the study team, once the data for other states are in is to a) evolve a common methodology, across departments, for measurement of the gap and, b) to prioritize the reasons for the gap so that action can be initiated in a more focused manner.

CHAPTER 5

KARNATAKA

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KARNATAKA

5.0 Secondary Data Provided On Irrigation Projects

Data provided by the department for the selected projects is analyzed separately for Major, Medium and Minor Projects and the same is presented below.

Major Irrigation

1. Vanivilas Sagar Project

The project is located in Hiriyur taluk of Chitradurga district. It was completed in the year 1907. The dam is constructed across Vedhavathi River. Villages of Hiriyur taluk are benefited with irrigation facility. The project has a dam and functions through pick up weir at Kathrikenahally village.

The planned irrigated area under the project is 12135 Ha. The percentages of irrigated area over the potential contemplated as per the project proposal are shown table 5.1 and the gap is 40-55% over these 5 years. Rainfall reduction in the command area is attributed as reason for these gaps.

Table 5.1 Percentage of Area Irrigated to the Potential Created Over the Reference Years

Percentage of area irrigated to the potential created over the period 2002-03 to 2006-07					
Year	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**
Area Irrigated	7280	7501	5695	5662	5557
% of acreage irrigated to the potential created	59.99	61.81	46.93	46.66	45.79
Gap	40.01%	38.19%	53.07%	53.34%	54.21%

2. Ghataprabha Project, Stages I & II

A reservoir is built across the river Ghataprabha, a tributary to river Krishna near Hidkal in Hukkeri taluk of Belguam district. The planned irrigated area under these stages of the project is 1,39,383 Ha. There is no gap in the irrigation potential created and utilized under the project.

3. Hemavathy Project

The project benefits Hassan, Tumkur, Mandya and Mysore districts of the state. The total yield envisaged in the project proposal is 78.607 TMC and out of that 52.28 TMC is meant for flow irrigation and project has been completed in 1980. The envisaged yield is not realised in 12 years as per the project report upto 2002.

Hemavathy is a major irrigation project having an Ayacut of 2.84 Lakh Hectares. 2.65 Lakh hectares of this Ayacut get water through flow irrigation. It consists of Left bank, Right bank and Right bank High Level canals. The left bank canal has two branch canals namely Tumkur branch canal and Nagamangala branch canal.

Distributory wise data pertaining to the main canals is provided. Reduction in rainfall and cropping pattern violation have occurred under the project command area resulting wide variations in the water availability and irrigated areas across the distributory.

Medium Irrigation

1. Harangi Reservoir Project (On going)

The project is constructed across river Harngi, a tributary of Cauvery at Hulugunda in Somwarpet Taluk, Kodagu district. Districts benefited are Kodagu, Hassan and Mysore. Total yield envisaged in the project proposal is 39.30 TMC. Quantity meant for irrigation is 18.00 TMC. Out of 30 years designed yield is received in 15 years as per project report upto 2002 The potential created up to end of March 2007 is 48165 Ha. The total irrigable are under two canals (LBC and RBC) is 40790 ha.

2. Chicklihole Reservoir Project

The project was completed in 2007. District benefited: Kodagu.Total Yield Envisaged in the project proposal TMC: 0.623 TMC quantity meant for irrigation 0.474 TMC. .Out of 19 years designed yield is received in 9 years as per project upto 2002.

3. Lower Mullamari Dam (Under progress)

The project is located at Nagaral Village, Chinchili tq, Gulbarga District.Gulbarga district is benefited and total yield envisaged in the project is 2.61 TMC for irrigation purpose only and yield is realised 23 times as per the project upto 2002. The contemplated aychkat under the distributory amount to 8100 Ha and potential created available as of now is only for 7430 Ha. Detailed 64 distributory wise data is available for the period 2002-03 to 2006-07.

The project has released water for irrigation purpose upto distributory 34 on trail basis during Rabi season in 2005-06 and 2006-07 to irrigate on area of 3928 ha and subsequently stopped due to leakage of the main canal.

4. Hagaribommanalli Pickup,

The project is located at Malvi near Hagaribommanahalli, Bellary District. Project was completed in 1981. It benefits Bellary district and the total yield envisaged in the project proposal is 5.19 TMC and out of that 3.00 TMC is meant for irrigation purpose. Yield was realised only 6 times in 21 years up to 2002 as per the project report. Water for irrigation was not released during years 2002-03, 2003-04, 2005-06 and 2006-07.

1. During the year 2004-05, the project was able to provide 54.41% and 68.54% of the quantum to be supplied through the right and left bank canals respectively. 62.82% of 2973 Ha of command area under all distributaries was benefited with irrigation during this year.

Grouping the quantum to be supplied through each of the canal distributory, the percentage gaps in irrigation supply and acreage irrigated are worked out (Table 5.2) to examine and view the relationship between the quantum of water flow and percentage of gap in area irrigated.

Table 5.2 Distributory Wise Irrigation Potential Created and Utilized Under H.B.Halli Project

Sl.No	Dy. Supply Range (Cusecs)	Quantum of water to be supplied (Cusecs)		Area to be irrigated in hectares		% of gap in water availability for irrigation		% of gap in irrigated acreage	
		RBC	LBC	RBC	LBC	RBC	LBC	RBC	LBC
1	Up to 2.00	16.62	18.89	355.98	395.20	39.83	31.18	41.38	29.27
2	2.00 to 3.00	15.33	4.02	286.71	77.85	38.62	50.00	37.41	49.78
3	3.00 to 4.00	17.56	9.68	340.36	185.19	40.32	8.16	38.59	7.65
4	4.00 to 5.00	26.82	11.14	614.69	229.53	56.60	14.81	56.88	14.63
5	More than 5		24.24		487.73		45.54		45.43
	Total	76.33	67.97	1597.74	1375.50	45.59	31.46	46.04	30.81

5. Maskinala Project

The project is located near Maraladinni village in Lingasugur taluk of Raichur district across the river Maskinala, a tributary to river Tungabhadra. The project is planned to irrigate 2833 Ha of area. A gap of 545 Ha of area exists between the irrigation potential created (2724 Ha) and utilized (2170 Ha) up to 03/2007.

6. Anjanapura Tank

The reservoir was constructed across the river Kumudavathy in Shimoga district in 1936. The project is planned to create irrigation facility for 6736 Ha of area and the gaps of acreage utilization over the potential created are about 10-14% under this project (Table 5.3). Reduction in rainfall is the reason for this gap.

Table 5.3 Percentage of Area Irrigated To the Potential Created Over the Reference Period

Percentage of area irrigated to the potential created over the period 2003-04 to 2006-07					
Year	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**
Area Irrigated	5850	6020	6047	6047	6057
% of acreage to the potential created	86.85	89.37	89.77	89.77	89.92
% Gap	13.15%	10.63%	10.23%	10.23%	10.08%

7. Manchanabele Reservoir Project

It is located near Manchanabele village in Magadi taluk, Ramnagaram district across the river Arkavathy, a tributary to river Cauvery and completed in 1993. Total yield envisaged in the project proposal was 1.22 TMC and out of which 0.785 TMC is for irrigation purpose. Only 3 times the yield is realised as per project report upto 2002.

In flow canal total atchkat area is 3035 Ha. Out of which 759 Ha in 2005-06 and 2306 Ha in 2006-07 are provided with irrigation facility on experimental basis. As distributory works are nearing completion and reduction in rainfall and yield the gap in utilisation over irrigation potential created persists in the project. Only 246 Ha of area irrigated with a supply 0.312 TMC during 2006-07 through its Left Bank canal and 264 Ha of area irrigated with a supply of 0.336 TMC during 2006-07 through its Right Bank canal system.

8. Arkavathy Reservoir project

It is located near Arobele village, Kanakapura Taluk, Ramnagaram district. It is an on going project. 3.13 TMC of water is panned for irrigation purpose out of 6.92 TMC of envisaged quantum of water in the project report.

9. Iggalur Barrage project

It is located near Iggalur village, Channapatna taluk, Ramnagarm district across the river Shimsha. It was completed in 1996. As per the project report 0.94608 TMC of water for kharif and 0.834379 TMC of water for summer perennial crops irrigation out of expected 0.182 TMC of yield is provided under the project.

Power interruption and cropping pattern violation have resulted in lower irrigated area. Envisaged water supply is not possible due to reduction in rainfall in the region. Detailed data for 5 years is available.

Minor Irrigation

Minor Irrigation Projects are those having CCA (Culturable command area) of 2,000 ha or less in the state. The construction, maintenance and monitoring of Minor Irrigation Projects will come under the purview of Minor Irrigation Department. The ultimate Irrigation Potential of Minor Irrigation Projects in the state is estimated as 10.00 Lakhs hectares.

At present 4.09 lakh hectares of land is entirely dependent on 3,338 minor irrigation tanks with a storage capacity of 1.13 lakh million cubic feet of water in the state for irrigation. The overall food grain production of the state is highly dependent on the irrigated cropped areas under tanks that are mostly in rainfed areas of the state. The gap between the irrigation potential created and utilization will be widened with a monsoon failure in any year.

The state highly depends upon rainfall received in three seasons of the year. However the occurrence and distribution of rainfall in the State is highly erratic. The annual normal rainfall is 1138 mm received over 55 rainy days. It varies from as low as 569 mm in the east to as high as 4029 mm in the west. About 2/3rd of the geographical area of the State receives less than 750 mm of rainfall. Even assured rainfall areas of the State have experienced scarcity of water in some years.

The importance of normal rainfall can be understood with the following facts. At the end of June month, 1,095 of the 2,001 minor irrigation tanks in south Karnataka districts have not received any inflow, and of the 1,337 minor irrigation tanks in north Karnataka districts, 557 have not received any water this year. More than 49 per cent of the minor irrigation tanks in the State have not received even a drop of water and 38.1 per cent of the tanks are filled to 30 per cent of their capacity.

This affects the crops to be grown and time to start the agricultural activities. Tumkur, Belguam, Kolar, Bijapur and Gulbarga are some of the districts with a high concentration of tanks in the state.

The minor irrigation sources include tanks, wells both public and private control and lift irrigation schemes. These minor irrigation sources are under different jurisdictions and control. While the 0-4 hectare minor irrigation sources were managed by the taluk panchayats, sources with the irrigation potential from 4-40 hectares are managed by the zilla panchayats. The minor irrigation projects having a command area up to 2,000 hectares were managed and maintained by the Minor Irrigation Department. The government aims to create an ultimate irrigation potential of 45 lakh hectares under major, medium and minor irrigation projects and facilitate creation of an additional irrigation potential of 16 lakh hectares by individual farmers using ground water. The groundwater resources of the state are not uniformly utilized and there is over exploitation in some districts where the rainfall is very low. Consequently the bore wells could not be charged and the water yields have come down even to supplement the agricultural activities. More than 80 percent of gap exits between the irrigation potential created and utilized over the study periods with respect to minor irrigation projects in both the zones of Karnataka. (Table 5.4 and 5.5)

Table 5.4 Minor Irrigation Projects in North Zone of Karnataka state

Percentage of gap of irrigation utilization over potential created						
	District	**2002-03**	**2003-04**	**2004-05**	**2006-07**	**2007-08**
1	Belguam	58.67	63.35	65.92	66.6	63.08
2	Bijapur	91.02	99.64	91.04	87.37	77.64
3	Bagalkot	87.47	86.66	85.74	84.7	85.65
4	Dharwad	100	100	88.4	95.33	100
5	Gadag	88.81	85.67	83.35	91.1	91.25
6	Haveri	98.42	98.49	96.41	82.5	79.18
7	Uttar-Kannada	97.73	97.54	92.34	80.16	92.78
8	Gulbarga	98.13	98.66	96.35	85.86	95.57
9	Bidar	87.73	87.78	94.91	91.67	87.55
10	Bellary	93.47	95.1	84.22	81.32	85.72
11	Raichur	88.76	88.18	86.9	74.83	83.73
12	Koppal	100	94.72	89.13	89.77	90.91
Zone Total		88.12	89.56	86.87	82.09	83.56

Table 5.5 Minor Irrigation Projects in South Zone of Karnataka State

Percentage of gap of irrigation utilization over potential created						
	District	2002-03	2003-04	2004-05	2005-06	2006-07
1	Bangalore Urban	73.48	93.74	98.1	93.88	92.56
2	Bangalore Rural	96.9	92.99	83.62	87.11	85.98
3	Kolar	100	100	100	81.19	100
4	Tumkur	97.95	100	100	100	100
5	Chitradurga	85.22	100	100	97.49	100
6	Davagere	100	100	100	80.44	85.17
7	Shimoga	99.12	88.63	35.59	58.71	64.07
8	Mysore	76.94	78.62	58.01	58.44	60.77
9	Chamarajnagar	97.98	100	87.8	78.44	97.51
10	Mandya	98.02	100	90.53	74.01	92.53
11	Hassan	100	100	93.85	86.82	96.66
12	Chickmagalur	80.45	100	53.25	78.67	87.28
13	Dakshina Kannada	87.93	86.66	86.6	81.81	90.46
14	Udipi	98.05	96.79	100	92.62	95.57
15	Kodagu	87.89	100	95.96	88.65	97.63
Zonal Total		93.14	96.22	82.95	80.31	88.48

5.1 Main reasons attributed for the gaps persisting in MI over periods

a) Scanty rains in this region
b) Old tanks are highly silted. Clean-up is needed.
c) Distribution canals are also highly silted. Need repair works to be taken up.
d) Old tanks loss 50-75 percent due to silt.
e) Lift Irrigation Schemes suffer due to irregular power supply upto 50 percent loss and defunct presently.
f) Ayacuts for pickups defunct pumping machinery is old and damaged.
g) Meagre maintenance resulting flow of water and lifting of water.
h) Farmers are not irrigation minded. Need training.

5.2 Some of decisions taken by the state government related to Minor Irrigation projects

- Rejuvenation of minor irrigation sources is given major trust.
- More budget allocation to minor irrigation
- Lake development authority is being strengthened to remove the encroachment and protect the traditional water bodies like tanks and lakes.
- To restore many of the minor irrigation tanks in Karnataka through a community-based approach. Villagers will get the chance to improve their tanks and they are prepared to maintain the tanks afterwards. The Jala Samvardhane Yojana Sangha (JSYS) is established as a nodal agency to implement the Karnataka Community-Based Tank Management Project.

5.3 Estimation of Gap between Irrigation Potential Created and Utilized (Karnataka)

Data was collected, through a structured and pretested questionnaire, from a total of 500 farmers, covering Major, Medium and Minor irrigation schemes in Karnataka. To make the sample representative, to the extent possible, of the entire state, a total of 19 districts were covered under the survey. Totally 64 villages were covered across the three types of irrigation schemes. Special efforts were made, while selecting the villages, to provide adequate representation to the farmers in the head reach, mid reach and tail reach. The details of sample selected under major, medium and minor projects and comprehensive analysis of primary survey data analysis is presented in Annexure 7

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project
- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers.

Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach is also identified. In addition, the area of the sample farmers under major, medium and minor irrigation schemes is also identified. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 2310.75 acres. Of this area, 434.50 acres are in the head reach, 670 acres are in the mid reach and the remaining 452.25 acres are in the tail reach. Similarly, 846 acres are under major irrigation projects, 710.75 acres are under medium irrigation projects and the remaining 754 acres are under minor irrigation projects (Table 5.6)

Table 5.6 Area under Irrigated Crops (acres)

Irrigated Area Owned						
		2006-07				
		H	M	T	Minor	Total
Category of Project	Major	322.50	257.50	258.50	.	838.50
	Medium	103.00	408.00	187.00	.	698.00
	Minor	.	.	.	753.00	753.00
Total		425.50	665.50	445.50	753.00	2289.50
Irrigated Area Leased in						
		2006-07				
		H	M	T	Minor	
Category of Project	Major	5.00	1.00	11.50	.	17.50
	Medium	4.00	3.50	6.25	.	13.75
	Minor	.	.	.	1.00	1.00
Total		9.00	4.50	17.75	1.00	32.25
Irrigated Area Leased out						
		2006-07				
		H	M	T	Minor	
Category of Project	Major	0.00	0.00	10.00	.	10.00
	Medium	0.00	0.00	1.00	.	1.00
	Minor	.	.	.	0.00	0.00
Total		0.00	0.00	11.00	0.00	11.00
Total Irrigated Area (Owned + Leased in -Leased out)						
		2006-07				
		H	M	T	Minor	
Category of Project	Major	327.50	258.50	260.00		846.00
	Medium	107.00	411.50	192.25		710.75
	Minor				754.00	754.00
Total		434.50	670.00	452.25	754.00	2310.75

In the year 2006-07, the gap is the highest under the minor irrigation schemes in both Kharif and Rabi seasons. While the overall gap is only 5.46 percent in Kharif season, it is almost 60 percent in the Rabi season. It is possible that the projects under study are actually meant for providing irrigation water only in the kharif season and hence it may

not be relevant to calculate the gap for rabi season. At the same time it is also possible that the projects under study are meant for providing complete or partial irrigation in the rabi season in which case the gap is to be calculated in order to get the complete picture. Unfortunately, there was no information or data from the state department of irrigation and hence there the gap is calculated to provide an indication of the irrigation potential created and utilized. One of the interesting aspects of Karnataka state is that the gap is the lowest in the tail reaches in kharif season (Table 5.7).

Table 5.7 Gap between Irrigation Potential Created and Utilized (Based on Data from Sample Farmers)

Gap (Percentage)							
Kharif							
		2006-07					
		H	**M**	**T**	**Minor**		**Gap (%)**
Category of Project	**Major**	302.50	247.75	252.50	.	802.75	5.11
	Medium	108.75	376.50	196.25	.	681.50	4.12
	Minor	.	.	.	700.25	700.25	7.13
Total		411.25	624.25	448.75	700.25	2184.50	5.46
Gap (percentage)		5.35	6.83	0.77	7.13	5.46	
Rabi							
		2006-07					
		H	**M**	**T**	**Minor**		
Category of Project	**Major**	96.25	100.75	139.95	.	336.95	60.17
	Medium	56.00	157.50	80.50	.	294.00	58.64
	Minor	.	.	.	303.05	303.05	59.81
Total		152.25	258.25	220.45	303.05	934.00	59.58
Gap (percentage)		64.96	61.46	51.25	59.81	59.58	
Summer							
		2006-07					
		H	**M**	**T**	**Minor**		
Category of Project	**Major**	27.00	33.50	22.75	.	83.25	90.16
	Medium	13.00	5.50	6.75	.	25.25	96.45
	Minor	.	.	.	41.25	41.25	94.53
Total		40.00	39.00	29.50	41.25	149.75	93.52
Gap (percentage)		90.79	94.18	93.48	94.53	93.52	

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them as presented in Table 5.8.

Table 5.8 Limits of Gap Based On Survey Data Analysis

Category	No of sample farmers	Kharif			Rabi			Summer		
		Gap %	Lower Limit	Upper Limit	Gap %	Lower Limit	Upper Limit	Gap %	Lower Limit	Upper Limit
Major	179	5.11	1.88	8.34	60.17	53.00	67.34	90.16	85.80	94.52
Medium	145	4.12	0.88	7.36	58.64	50.62	66.66	96.45	93.44	99.46
Minor	127	7.13	2.65	11.61	59.81	51.28	68.34	94.53	90.58	98.48
Head	77	5.35	0.32	10.38	64.96	54.30	75.62	90.79	84.33	97.25
Mid	145	6.83	2.72	10.94	61.46	53.54	69.38	94.18	90.37	97.99
Tail	102	0.77	0.00	2.47	51.25	41.55	60.95	93.48	88.69	98.27
Total	451	5.46	3.36	7.56	59.58	55.05	64.11	93.52	91.25	95.79

5.4 Summary and Conclusions

There are several learnings from this chapter. While there is no question about the presence of a gap between irrigation potential created and utilized, trying to figure out the exact size of this gap and the reasons thereof are riddled with methodological and procedural problems. First, different organizations connected with irrigated agriculture follow different methods for estimating the gap. Second, the concerned departments either do not maintain or are unwilling to part with the crucial data that is needed to address this issue, at the project level. Third, nevertheless, some common explanations for the gap have emerged from the study irrespective of the methodology used. The gap

in the minor irrigation is much higher than major and medium projects. Major reasons for higher gap in Minor Irrigation include:

- Scanty Rain Fall
- Silting of Tanks
- Farmers are not irrigation minded
- Irregular Power supply in lift irrigation schemes

There are other issues such as a) Difficulties in setting up of Water User Associations and problems in the functioning of many existing water users associations b) non-adherence to cropping pattern originally envisaged and, c) technical problems, particularly lack of proper maintenance at the canal level due to insufficient funds.

The gap in the major/medium projects varies from a high of 6.83 and low of 0.77 in percentage terms for Kharif Season. The gap is much higher in Rabi and varies from 51.25 to 64.96 percent. The Gap for summer crops is above 90 percent. However, one noticeable feature is that gap is lower in tail end compared to middle reach and head reach. This is partly attributed to delivery mechanisms initiated by Water User Associations. What is not really clear is the gap statistics available at the national and how they got computed, whether they are weighted average of all the seasons or maximum reported in any one season. This study clearly brings out that there is wide variation between what is reported in national level statistics as well as secondary data made available to the study team and field data both on the basis of selected projects secondary information and as per the primary survey analysis.

CHAPTER 6

TAMIL NADU

CHAPTER 6

TAMIL NADU

6.0 Secondary Data Provided On Irrigation Projects

Data provided by the department for the selected projects is analyzed separately for Major, Medium and Minor Projects and the same is presented below.

Major Irrigation

1, Sathanur Reservoir (Left Bank Canal)

The reservoir with a capacity of 36.47 MCft formed across the river Nagariar in Devadhanam Taluk in Virudhunagar district. The Vidurunagar gets the irrigation water through this project. Total yield envisaged in the project proposal is 0.208 TMC and 0.073 is for irrigation purpose. Table 6.1 presents the planned and actual utilization of irrigation potential created under the reservoir

Table 6.1 Planned and Actual Utilization of Irrigation Potential Created Under the Reservoir

Year	Planned(As per the project report)		Actual Utilisation	
	Quantum to be supplied (TMC)	Area to be Irrigated (Ha)	Quantum supplied (TMC)	Area Irrigated (Ha)
2002-03	0.073	1267		
2003-04	0.073	1267		
2004-05*	0.073	1267	0.110	1267
2005-06	0.073	1267	0.080	1267
2006-07	0.073	1267	0.458	1267

- The project is completed in 2004

The project is able to get sufficient inflow of water into the reservoir to irrigate the planned acreage in the command area and there is no gap in the irrigated area planned and utilized in the reference period.

Medium Irrigation

1. Manimuktha Nadi Dam

The Reservoir with a capacity of 737 Mcft. was constructed across Manimuktha Nadhi River during 1966-70 in Sankarapuram Taluk of Villupuram District. Manimuktha

Nadhi is one of the Major tributaries of the vellar. The catchment area of the river at the dam site is 187 square miles.

This Project also comprises two sluices in the right flank of earth dam one for the new main canal (1699.68) and the other (20.23) to feed the existing ayacut of Agarakottalam, which gets submerged in the reservoir. This Reservoir was put into beneficial use from 1970

Villages benefiting from the project are 1) Agarakottalam, 2) Anikkaraikottlam, 3) Thandalai, 4) Peruvangur, 5) Veeracholapuram, 6) Neelamangalam, 7) Madur, 8) Niraimathi, and 9) Kurur

The surplus arrangements now available for 32,700 cusecs are not adequate, as this Reservoir has experienced during 2005 with a maximum surplus of more than 50,000 cusecs. Regulators of surplus arrangements require petty repairs.

GAP: Total Registered ayacut for New Irrigation is 1719.92 ha. The gap estimated is around 263.05 ha, which comes around 16%.

Minor Irrigation

1. Nambiyar Reservoir

Located at Kottaikarungulam village in Radhapuram taluk (Tirunelvi district) benefits Tirunelveli district The total yield envisaged in the project report is 0.211 TMC and out of that 0.162 TMC is meant for irrigation purpose. The project was completed in 2004.

Due to reduction in rainfall in 2004-05, 2005-06, 2006-07, the reservoir could not supply water to the envisaged acreage. The following table shows how the reduction in rainfall has curtailed the area to be irrigated. 90% of the envisaged acreage could get the irrigation facility with the 63% realised yield in 2006-07 (Table 6.2). The gap is due to shortage of rainfall in the catchment.

Table 6.2 Planned and Actual Utilization of Irrigation Potential Created In 2005-06 and 2006-07

Main Canal	Planned as per the project proposal		Quantum realized		Acreage Irrigated	
	Quantum of water (TMC)	Acreage (Ha)	2005-06	2006-07	2005-06	2006-07
Left	0.075	382.5	20.00%	22.67%	20.0%	22.7%
Right	0.087	323.5	33.33%	63.22%	33.3%	87.9%

2. Kodumudiyar Reservoir

Located at Tirukkurungudi village in Nanguneri taluk (Tirunelveli district), the reservoir has 0.308 TMC as its total yield envisaged in the project proposal and 0.259 TMC is allocated for irrigation purpose. Assured supply to a total registered ayacut of 2430 Ha (5780 Acers) under Tamaraiyar system through three existing canals namely Valliooranka1, Padalayarkal and Vadamalayankal and 44 system tanks in 17 villages lying in Nanguneri and Radhapuram Taluk of Tirunelveli District is planned as per the project proposal.

The distributory wise data presented below shows that there are gaps between the planned potential created and utilization due to reduction in rainfall as reported. Irrigated area has reduced proportional to the quantum of water available through the distributory concerned (Table 6.3).

3. Sidhamalli Reservoir

The project was completed in 1998 and since then the total yield envisaged 0.4343 TMC has not been realized fully in any year. It is located at Kargudy village in Trichy district and benefits the Ariyalur district. The potential acreage created under the project is 477.34 Ha for wet crops and 1579.60 ha for dry irrigated crops.

Data on quantum potential created and realized over 5 years reveals that the yield is not fully realized at any point of time in the project. Maximum 30% of the reservoir is filled in 2005-06. The reasons attributed are 1) Reduction in rainfall, 2) Reduction in yield and 3) Wastage due to breaches (Sudden inflow and sudden discharge through the surplus regulator)

Table 6.3 Planned and Actual Utilization of Irrigation Potential Created Under the Minor Project

			Kodumudiyar Reservoir Project					
	Name of distributory	**Year**	**Quantum to be supplied (TMC)**	**Area to be irrigated (Ha)**	**Quantum supplied (MCFT)**	**% yield realized over planned**	**Area irrigated (Ha)**	**% acreage irrigated over planned**
1	Valliyoorankal	2004-05	0.159	523.9	0.069	43.40	227.3	43.39
		2005-06	0.159	523.9	0.167	105.03	523.9	100.00
		2006-07	0.159	523.9	0.070	44.03	230.6	44.02
2	Padlayakal	2004-05	0.150	495.1	0.092	61.33	303.7	61.34
		2005-06	0.150	495.1	0.157	104.67	495.1	100.00
		2006-07	0.150	495.1	0.152	101.33	495.1	100.00
3	Vadamalayankal	2004-05	0.205	1320.5	0.043	20.98	276.9	20.97
		2005-06	0.205	1320.5	0.123	60.00	792.3	60.00
		2006-07	0.205	1320.5	0.048	23.41	309.2	23.42

Irrigated dry crops could not be grown as envisaged in 1580 ha of the command area with an exception in 2005-06. Unless the reservoir is filled as planned over years the planned acreage of irrigation under the project cannot be achieved (Table 6.4)

Table 6.4 Planned and Actual Utilization of Irrigation Potential Created Under the Minor Project

Year	**Quantum supplied (TMC)**	**Irrigated Area (Ha)**	**% quantum supplied over the planned**	**% irrigated area over the planned**	**% Gap in water supply**	**% Gap in irrigated area**
2002-03	0.08022	194.87	18.47	9.47	81.53	90.53
2003-04	0.10659	258.92	24.54	12.59	75.46	87.41
2004-05	0.12537	304.54	28.87	14.81	71.13	85.19
2005-06	0.12845	1202.34	29.58	58.45	70.42	41.55
2006-07	0.03280	100.00	7.55	4.86	92.45	95.14

As per the project report: Irrigation potential created: 0. 4343 TMC and Area to be irrigated: Wet 477.34 Ha and Dry 1579.60 Ha

4. Poigaiyar Reservoir

This scheme is mainly to utilize the available floodwater from the Poigai Malai. The available water is used for stabilizing 194.04 ha of existing wet irrigation, which comes under 16 rain fed tanks, and bridging a gap of 56.66 ha. Four villages are benefited in Kanyakumari and Tirunelveli districts to arrest damages normally caused by the heavy flood during the NE monsoon and enable the local tanks get filled. However there is a gap of 26% during the reference period under this reservoir as shown table 6.5.

Table 6.5 Planned And Actual Utilization Of Irrigation Potential Created Under The Minor Project.

Year	Planned (As per the project report)		Actual utilization		
	Quantum to be supplied (Mcft)	Area to be irrigated (Ha)	Quantum supplied (Mcft)	Irrigated area (Ha)	% Gap in area irrigated
2002-03	138.27	383.58	12.614	285.58	25.55%
2003-04	138.27	383.58		285.58	25.55%
2004-05	138.27	383.58		285.58	25.55%
2005-06	138.27	383.58	28.69	285.58	25.55%
2006-07	138.27	383.58		285.58	25.55%

5. Kirumampakkam Tank

This is a system tank with WSA of 62.16 ha of water spread area and benefits the villages Kirumampakkam and Pillayarkuppam

The gap in the area irrigated has reduced from 203 ha in 2002-03 to 150 ha in 2006-07 as the ayacut area is sold out for non agriculture use to the extent of in years 2004-05, 2005-06 and 2006-07. The quantum of water available for irrigation is under utilized in this minor project (Table 6.6).

As per the project report: Irrigation potential created: 43.0 (Mcft) and Area to be irrigated: 203 Ha

Table 6.6 Planned and Actual Utilization of Irrigation Potential Created Under the Minor Project

Year	Quantum supplied (TMC)	Irrigated Area (Ha)	% quantum supplied over the planned	% irrigated area over the planned	% Gap in water supply	% Gap in irrigated area
2002-03	43.00	203	100.00	100.00	0.00	0.00
2003-04	43.00	203	100.00	100.00	0.00	0.00
2004-05	38.76	183	90.14	90.15	9.86	9.85
2005-06	34.95	165	81.28	81.28	18.72	18.72
2006-07	31.77	150	73.88	73.89	26.12	26.11

6.1 Estimation of Gap between Irrigation Potential Created and Utilized (Tamilnadu)

Data was collected, through a structured and pre tested questionnaire, from a total of 475 farmers, covering Major, Medium and Minor irrigation schemes in Tamilnadu. To make the sample representative, to the extent possible, of the entire state, a total of 7 districts were covered under the survey. Totally 18 villages were covered across the three types of irrigation schemes. Special efforts were made, while selecting the villages, to provide adequate representation to the farmers in the head reach, mid reach and tail reach. The details of sample selected under major, medium and minor projects and comprehensive analysis of primary survey data analysis is presented in Annexure 8

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project

- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers.

Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach is also identified. In addition, the area of the sample farmers under major, medium and minor irrigation schemes is also identified. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 2029.22 acres. Of this area, 514.25 acres are in the head reach, 313.00 acres are in the mid reach and another 220.00 acres are in the tail reach. Similarly, 545.10 acres are under major irrigation projects, 502.15 acres are under medium irrigation projects and the remaining 981.97 acres are under minor irrigation projects as in table 6.7.

In the year 2006-07, the gap is the highest under the medium irrigation schemes in Kharif season. On the other hand, the gap is highest under the minor irrigation schemes in the Rabi season. While the overall gap is 25.64 percent in Kharif season, it is much higher at 82.82 percent in the Rabi season. It is possible that the heavy monsoons in Tamilnadu

could have contributed to low percentage of the gap in the kharif season. Unfortunately, there was no information or data from the state department of irrigation and hence the gap is calculated to provide an indication of the irrigation potential created and utilized.

Table 6.7 Area under Irrigated Crops (Acres)

Owned						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
Category	**Major**	151.65	215.95	184.50		552.10
	Medium	358.60	97.55	31.00		487.15
	Minor				980.67	980.67
Total		510.25	313.50	215.50	980.67	2019.92
Leased IN						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
Category	**Major**	2.00	0.50	6.00		8.50
	Medium	17.00	0.50	0.00		17.50
	Minor				1.30	1.30
Total		19.00	1.00	6.00	1.30	27.30
Leased Out						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
Category	**Major**	14.00	1.50	0.00		15.50
	Medium	1.00	0.00	1.50		2.50
	Minor				0.00	0.00
Total		15.00	1.50	1.50	0.00	18.00
Total Irrigated Area						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
Category	**Major**	139.65	214.95	190.50	0.00	545.10
	Medium	374.60	98.05	29.50	0.00	502.15
	Minor	0.00	0.00	0.00	981.97	981.97
Total		514.25	313.00	220.00	981.97	2029.22

One of the interesting aspects of Tamilnadu is that the percentage of the gap is lower in the tail reaches in the kharif season. This could be due to the fact that the sample farmers in the tail reaches are using the irrigation water more judiciously and / or favorable monsoons. On the other hand, the gap in the tail reaches is the highest in both Rabi and Summer seasons.

Area under Irrigated Crops (acres) and Gap between Irrigation Potential created and Utilized (based on data from Sample farmers) are presented in table 6.8

Table 6.8 Gap between Irrigation Potential Created and Utilized (Based On Data from Sample Farmers)

Kharif							
		2006-07					
		H	M	T	Minor	Total	GAP (%)
Category	Major	137.00	150.75	139.50		427.25	21.62
	Medium	230.05	16.50	17.50		264.05	47.42
	Minor				817.65	817.65	16.73
Total		367.05	167.25	157.00	817.65	1508.95	25.64
GAP (Percent)		28.62	46.57	28.64	16.73	25.64	
Rabi							
		2006-07					
		H	M	T	Minor	Total	GAP (%)
Category	Major	26.00	36.50	12.50		75.00	86.24
	Medium	155.10	70.05	13.00		238.15	52.57
	Minor	0.00			35.50	35.50	96.38
Total		181.10	106.55	25.50	35.50	348.65	82.82
GAP (Percent)		64.78	65.96	88.41	96.38	82.82	
Summer							
		2006-07					
		H	M	T	Minor	Total	GAP (%)
Category	Major	23.00	29.25	6.00		58.25	89.31
	Medium	29.00	0.00	0.00		29.00	94.22
	Minor				183.65	183.65	81.30
Total		52.00	29.25	6.00	183.65	270.90	86.65
GAP (Percent)		89.89	90.65	97.27	81.30	86.65	

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them (Table 6.9)

Table 6.9 Limits of Gap Based On Survey Data Analysis

Category	No of sample farmers	Kharif			Rabi			Summer		
		Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit
Major	170	21.62	15.43	27.81	86.24	81.06	91.42	89.31	84.67	93.96
Medium	130	47.42	38.83	56.00	52.57	43.99	61.16	94.22	90.21	98.23
Minor	159	16.73	10.93	22.54	96.38	93.48	99.29	81.30	75.24	87.36
Head	153	28.62	21.46	35.79	64.78	57.22	72.35	89.89	85.11	94.67
Mid	89	46.57	36.20	56.93	65.96	56.11	75.80	90.65	84.61	96.70
Tail	58	28.64	17.00	40.27	88.41	80.17	96.65	97.27	93.08	101.46
Total	459	25.64	21.64	29.63	82.82	79.37	86.27	86.65	83.54	89.76

6.2 Summary and Conclusions

The secondary data on major, medium and minor irrigations show that there are considerable gaps between the potential created and utilized as per the project reports in terms of quantum of irrigation water and area irrigated over the years 2002-03 and 2006-07. There is a wide variation in gap across minor irrigation projects.The major reasons for the gaps are 1) reduction of rainfall that in turn reduced the in flows into the reservoirs, 2) non agricultural usage of the irrigated areas that are close to the urban habitat and Wastage due to breaches (Sudden inflow and sudden discharge through the surplus regulator). As explained under medium irrigation projects, the retaining capacity of rain water during good monsoon years in the reservoir is a constraint in some cases and in some cases for wants of proper maintenance works on regular basis, the surplus water can not be put to use. Some of the minor irrigation projects are designed to support the local tanks whenever heavy floods occur and the area irrigated under the tanks is unpredictable. The gap calculated from secondary data and from the analysis primary data reveal the same trend even though there is variation in quantum of the gap. The gap experienced by tail enders is not much different from head reach farmers. The percentage of the gap is lower in the tail reaches in the kharif season. This could be due to the fact that the sample farmers in the tail reaches are using the irrigation water more judiciously and / or favorable monsoons. On the other hand, the gap in the tail reaches is the highest in both Rabi and summer seasons.

CHAPTER 7

KERALA

Chapter 7

KERALA

7.0 Water Resources Scenario in Kerala

The water resources of Kerala are greatly influenced by the unique rainfall pattern, geomorphology, geology, land use, vegetation and soils of this humid tropical region. The management of water resources has to take into consideration the environmental, social, economic and cultural factors of this geographical area. The 'water resources scenario' of the State is presented herein giving due weightage to the unique features of the State.

Important rainy seasons in the State are during south- west monsoon (June-September) and north-east monsoon (October- December). About 60% of the annual rainfall is received during south- west monsoon and 25% during north-cast monsoon and only the remaining 15% during the so called six summer months (December-May). The average annual rainfall in the State is 3000 mm. The rainfall varies considerably not only in time but also in space.

7.1 Unique Features of the Water Resources of Kerala

There are 44 rivers in Kerala of lengths more than 15 km; 41 of them flow towards the west and join the Lakshadweep Sea and the remaining 3 flow to the east and become tributaries of the Cauvery river system. Most of these rivers are ephemeral because the only input of water is from rainfall, mainly during the monsoons. It is important to note that these rivers are short and their basin areas are comparatively very small. The annual discharge from all the rivers of Kerala is estimated to be 78,041 million m^3 (Kerala PWD) while a single river like Godavari has an annual discharge of 1,05,000 million m^3. The transpiration from the natural trees and plants of uncultivated areas of this humid tropic region is estimated to be very high. The short, steep, fast-flowing, monsoon-fed rivers of Kerala with comparatively small basin areas are unique and call for certain management strategies, specifically evolved for this region.

According to the estimates made by Kerala PWD, using certain empirical relationships, the total stream flow from all the rivers is 78,041 million m3, of which 70,323 million m3 being the contribution from the catchments in Kerala State. The estimate made by CWRDM later using actual flow data shows that the total stream flow is 25% less than the estimate made by Kerala PWD in 1974. The utilizable quantity estimated by Kerala PWD is 42.772 million m3. This utilizable yield is worked out on the assumption that almost the entire runoff above 75 m contour is utilizable, 50% of the runoff between 15 m and 75m contour is utilizable and the entire runoff below 15m contour is unutilisable. Due to certain environmental and socio-cultural factors, the storage spaces as envisaged are not available, and therefore, there are several limitations in estimating the utilizable yield. Realizing the need for collecting more reliable data for estimation purposes, scientific data collection activities have been initiated as a part of the National Hydrology Project. Because of one or other environmental reason, no major/medium irrigation or hydroelectric project has been sanctioned to the State in the recent past. All these add to the problems associated with the management of the water resources of the State. The Government of Kerala has now initiated the preparation of a Master Plan aiming at the scientific water management in the State.

Some of the important irrigation projects in Kerala area 1. Malampuzha, 2. Kallada, 3.Kanchirampara, 4.Periyar, 5.Peechi, 6.Neyyar, and 7. Valayar

Table 7.1 Irrigation potential created and utilized (Ha) in Kerala

Irrigation Project Type	Irrigation potential created and utilized (Ha)			
	Ultimate	Created	Utilization	% of utilization over created
Major and Medium	1,000	609.49	558.87	91.69
Minor	1,679	646.02	603.76	93.46
Total	2,679.00	1,249.63	1,162.63	93.04

7.2 Water Management Problems

In a State with high variations in spatial and temporal rainfall, problems associated with water management are considerable. The geology and geomorphology also impose

several limitations. On one side, the necessity for large scale storages and diversions to cater to the requirements of deficit areas in the State have been highlighted by the engineering professionals while on the other, such schemes are opposed to by the environmentalists mainly by pointing out that areas with great biodiversity in the Western Ghats may got submerged. In a humid tropic region like Kerala, preservation of biodiversity, especially in the forest ecosystem, is as important as the water resources development. Most of the west-flowing rivers of Kerala drain into the wetlands, situated close to the Lakshadweep Sea. These wetlands are significant not only from the environment angle but also from the development angle. The Kuttanad and the *Kol* lands are the rice-bowls of Kerala and other wetlands also have several values related to fisheries, mangroves, inland navigation, etc. The midland and lowland belts of Kerala are thickly populated and the water requirements in these areas are much more, but, the fresh water availability and space for developing the same are limited. There has been considerable exploitation of groundwater sources in the midland and lowland belts, especially for domestic requirements. In addition to these, frequent floods and droughts, pollution, salinity intrusion, etc make the water management in this region highly complicated. It is in this background that one has to view the water management problems of the State.

Irrigation: The estimated irrigation potential of Kerala is 16 lakh ha, though there are several constraints to achieve this target. The storage capacity of major/medium Irrigation projects of Kerala is around 1,200 million m^3. During the past two decades, this figure has been almost constant, especially since necessary clearances have not been obtained for additional major/medium projects.

The details regarding the extent of wetlands and garden lands which require irrigation facility and to the extent to which irrigation facility has been extended and the deficit to be covered are furnished below:

Area wise Irrigation Requirements (Data as per CWRDM)

i) Wetlands (ha)		
	(a) Existing	6,12,863
	(b) Ultimate	6,99,700
ii) Garden lands (ha)		
.	(a) Existing	11,77,854
	(b) Ultimate	16,01,500

Present Irrigation Status

Net Area Irrigated (ha)	3,58,000
(a) Command *of* canals (ha)	1,12,000

(Government & private) (Mainly from commissioned and partially commissioned major/medium projects)

(b) Minor and lift irrigation (ha)	24210
(c) Tanks/ponds (ha) (government & Private)	53,370
(d) Wells (ha) (government & private)	75,870
(e) Other Sources (ha)	92,550

(All the government owned schemes and 25% *of* the privately owned tanks/ponds/wells are meant for wetlands, mainly rice).

Balance Area Required Irrigation (ha)

(i) Wetlands	
(a) Existing	4,59,695
(b) Ultimate	5,46,532
(ii) Garden land assuming only 50% *of* the total area	
(a) Existing	5,43,291
(b) Ultimate	7,55,144

The pattern of irrigation (Source-wise) is presented in Table 7.3. The area irrigated in the state as on 2001-02 is composed of 25.26% (Government canals), 1.17% (Private canals), 13.24% (Tanks), 22.88% (Wells) and 37.45% (Other water sources) areas. Paddy cultivation being an important wet crop in the state mainly takes away 42.57% of irrigated area under its fold. However the net area irrigated to net area sown is 17.20%.

Table 7.2 Pattern of Irrigation (Source-wise)

	Pattern of Irrigation (Source-wise)							
Sl. No	**Source**	**1960-61**	**197-71**	**1980-81**	**1990-91**	**1995-96**	**1990-00**	**2001-02**
1	Government Canals	133049	200553	99400	104265	103136	81231	95270
2	Private canals	5738	10160	5300	3691	3681	4803	4413
3	Tanks	46952	73113	5050	48952	49213	52932	49945
4	Wells	2032	5460	50920	65678	73137	121605	86297
5	Other sources	130940	141968	77300	110783	113026	119472	141237
6	Total	318711	431254	237970	333369	342193	380043	377162
7	Area Irrigated more than once in a year	137545	170131	143030		123311	90655	55055
8	Gross irrigated area	456256	601385	381000	384561	465504	470698	432217
9	Net area irrigated to net area sown (%)	16.57	19.86	1092	14.83	15.11	16.97	17.20
10	Gross irrigated area to gross cropped area (%)	19.4	20.5	13.21	12.73	15.18	15.68	14.44
11	Irrigated area under paddy to total irrigated area (%)	44.7	55.85	34.53	40.23	49.75	44.21	42.57

Source: Directorate of Economics and Statistics

7.3 Area irrigated by minor irrigation schemes

Kerala has a total irrigation potential of 1.5 million hectares and out of this 0.9 million hectares can be under minor irrigation based on an earlier study. Minor irrigation schemes are functionally responsible for the supply of irrigation water to the end users. This classification has been redefined in the revised Kerala water conservation act 2003. The revised classification is as follows.

Minor Irrigation schemes < 15 Ha

Medium schemes < 10000 Ha including Lift Irrigation schemes

Major schemes > 10000 Ha

Over the years, Kerala State has developed a number of Minor Irrigation Schemes which have contributed to the irrigation development of the State. Minor Irrigation Schemes can be broadly classified as surface flow irrigation schemes, surface lift irrigation schemes and groundwater based schemes. A complete census of all Minor Irrigation Schemes in Kerala was recently carried out as a collaborative effort of the Centre for Water Resources Development and Management and the Public Works - Department (Irrigation), Government of Kerala. The primary data were collected at the panchayat level and these data were analyzed and processed to obtain taluk level, district level and state level abstracts. The results obtained through this study should prove useful for evaluating the current status of' Minor Irrigation Schemes in Kerala State and also in proper planning of future irrigation development in the Kerala State through Minor Irrigation Schemes.

Compared to the other three states in southern India, irrigation dam and canal systems in Kerala are not extensive. The main prospects for irrigation based mini-hydro development are associated with the numerous diversion weirs and barrages that have been installed for irrigation and water supply purposes.

Kerala is the land of Rivers and Backwaters. Of 49 Rivers, 46 flow to the west and 3 to the east, which cut across Kerala with its innumerable tributaries and branches. These rivers that are small and monsoon fed, turnout to be rivulets in summer. The Backwaters form an attractive and economically valuable feature of Kerala. They include lakes and ocean inlets that stretch irregularly all along. The biggest backwater is the Vembanad Lake, which opens out into the Arabian Sea at Cochin Port. The other important backwaters are Veli, Kadinakulam, Anjingo, Edava, Madayara, Paravoor, Ashtamudi, Kayamkulam, Kodungallur and Chetwa. A navigable canal stretches from Thiruvananthapuram to Tirur. Physical achievements for the Minor Irrigation schemes are presented in Table 7.3

Table 7.3 Physical achievements for the Minor Irrigation Schemes

Year	*Target (Ha)*	*Achieved (Ha)*	*Gap (%)*
2001-02	5621	3744	33.39
2002-03	3587	4484	-25.01
2003-04	593	4897	-725.80
2004-05	6200	4426	28.61
2005-06	1040	3611	-247.21

The total outlay allotted by the State Planning Board for Minor Irrigation under surface water is Rs. 155 crore. During the first three years, till September 2004 an expenditure of Rs. 38 crore has been made against a budget provision of 63.87 crore.

7.3.1 Lift Irrigation Projects

Lift Irrigation involves lifting of water by mechanical means for irrigation. The Ayacut of lift irrigation schemes are more than 40 Ha. The sources of lift irrigation schemes are canals or rivers. There are around 430 lift irrigation schemes in Kerala which are functional. These are spread over mostly in Eranakulam, Malappuram, Palakkad, Pthanamthitta and Thrissur districts through which the major rivers of the state viz Periar, Muvattupuzha river, Bharathapuzha and Pamba river flows.

New lift irrigation schemes are selected based on the representations received from Public/farmers. The ceiling for new LI schemes is Rs. 50,000/Ha and that of maintenance is Rs. 1800/Ha. The benefit cost ratio for new LI schemes is to be greater than 1.5. Periodical maintenance is essential for LI schemes.

The operation and maintenance of the lift irrigation schemes are seriously affected by lack of funds. The State is trying to maintain the LI schemes properly by way of increasing the water cess and seeking the help of water users associations and local

authorities. About 27 lift irrigation schemes have been completed with NABARD assistance.

The minor irrigation schemes irrespective of their appropriateness to Kerala conditions, receive less attention with only about 14 to 17% of the overall investment in irrigation sector. The traditional water storages are mostly dilapidated due to negligence. While there is increased spending in the water sector, maintenance has not received adequate attention.

7.3.2 Gap in Minor Irrigation Schemes

According to a comprehensive study on "**Report on Survey of Minor Irrigation Schemes in Kerala – 2004 Department of Economics & Statistics Thiruvananthapuram 2006**", the area irrigated is far less than the area proposed. Due to deficiency of water, uneconomic nature of paddy cultivation, paddy fields are converted for housing and for other purposes. Change in the cropping pattern etc. is another factor for shortage in area. District wise data is presented in Table 7.4.

Other reasons reported for Ayacut reduction are

- Some of the major projects since completed have absorbed a certain portion of the Ayacut area served by Minor Irrigation Schemes.
- Some of the Minor Irrigation Schemes got damaged due to natural calamities have not since been repaired.
- The maintenance of Minor Irrigation class II works after completion rest with the concerned panchayats and the panchayats failed to attend the maintenance due to lack of funds etc.

The life of Minor Irrigation class II schemes and IPD Yelah is about 15 years maximum.

7.4 Challenges in the field of minor irrigation in Kerala

1. Conversion of agricultural land

Conversion of agricultural land for other purposes has become a common problem in the

state of Kerala. The reason for this is rapid and unhealthy urbanization of villages where major portion of agricultural land is situated. Even though there is legislation prohibiting

Table 7.4 District wise data on Ayacut Area proposed and achieved and the beneficiaries

Sl. No.	District	Ayacut Area (Ha.)		%Gap Cols (3)-(4)	Actual Area Irrigated (Ha)	%Gap Cols (3)-(6)	Number Of Beneficiaries		%Gap Cols (8)-9)
		Proposed	Achieved				Proposed	Achieved	
1	2	3	4	5	6	7	8	9	10
1	Kasaragod	20,438	12,957	36.6	7,843	39.47	37,641	29,519	21.58
2	Kannur	85,061	13,556	84.06	5,217	61.52	56,115	33,379	40.52
3	Wynad	15,352	4,563	70.28	3,527	22.7	16,140	7,670	52.48
4	Kozhikkode	16,431	5,133	68.76	2,170	57.72	30,163	11,614	61.5
5	Malappuram	73,127	22,738	68.91	12,934	43.12	51,439	45,696	11.16
6	Palakkad	34,260	27,489	19.76	14,925	45.71	57,365	37,735	34.22
7	Thrissur	57,892	31,801	45.07	6,791	78.65	55,977	21,207	62.11
8	Eranakulam	91,814	50,432	45.07	15,464	69.34	81,004	61,846	23.65
9	Idukki	39,269	26,582	32.31	6,297	76.31	62,710	30,018	52.13
10	Kottayam	37,466	22,288	40.51	6,016	73.01	47,372	27,058	42.88
11	Alappuzha	62,912	57,093	9.25	19,012	66.7	72,913	62,439	14.37
12	Pathanamthitta	32,944	25,309	23.18	5,576	77.97	78,370	50,143	36.02
13	Kollam	39,007	18,385	52.87	3,810	79.28	76,968	28,155	63.42
14	Thiruvananth a-puram	17,189	12,527	27.12	5,224	58.3	65,745	55,098	16.19
State		**623,162**	**330,853**	**46.91**	**114,806**	**65.3**	**789,922**	**501,577**	**36.5**

the conversion of land, the enforcement of the rules is not effective and hence the area of agricultural land available in Kerala is rapidly diminishing. Also clay mining in paddy fields destroys the fields totally.

2. Reluctance of people to take up agriculture as a profession.

   Nowadays in Kerala farmers are an endangered species. Due to various reasons it becomes impossible to make a living by taking up agriculture as a profession. This is due to the changed social and political situation in Kerala. When there is no agriculture there is no need of spending money on irrigation activities.

3. Deterioration of irrigation canals due to filling up, encroachment and waste dumping.
4. Lack of maintenance to irrigation structures due to scarcity of funds.
5. Lack of effective system to collect irrigation water cess and reluctance in the part of end users to pay the cess for irrigation water.

7.4.1 Suggestions to Improve the Present State

1. Prevent conversion of agricultural land by way of proper legislation and its effective implementation.
2. Create a social and political atmosphere to attract people to agricultural profession.
3. Implement *Participatory Irrigation Management* in the minor irrigation sector.
4. Create awareness about the importance of conservation of water.

Kerala Irrigation and water conservation act 2003 has been formulated for the consolidation and amendment of laws relating to the following aspects of irrigation. Formulation of rules for the implementation of the act is in progress

1. Conservation of water in water courses.
2. Construction of irrigation works and their classification.
3. Construction and maintenance of field channels.
4. Issue of certificates and levy of irrigation cess.
5. Obtaining materials in emergencies.
6. Regulation of water supply for irrigation.
7. Execution of works by joint labour
8. Safeguards for irrigation works.
9. Betterment contribution.
10. Participatory irrigation management.
11. Constitution of dam safety authority.
12. Penalties.

7.5 Future Plans

Based on the actual feedback from the people, the experience of the engineers and other professionals and also the knowledge gained from scientific investigations, the Government of Kerala has recognized the various problems associated with the water management of this humid tropical region. The Government has formulated several strategies aiming at the scientific management of the water resources of the State to cater to the requirements of the people. Some of these strategies are highlighted below:

- Kerala was the first among the States to adopt a Water Policy for the State which is being updated now considering the specific requirements of the people.

- The necessity for hydrologic data has been well recognized and under the National Hydrology Project, systematic data collection using modern instruments has been initiated in the State.

- Attempts are being made to establish a hydro-informatics system for the State.

- Studies are in progress to prepare river basin plans and subsequently to come out with a Master Plan for the development and management of the water resources of the State.

- The necessity for considering the social, economic and environmental factors in water resources development and management programmes has been recognized and these factors are now considered right at the planning stage.

- Several scientific studies on the water resources of Kerala have .been initiated by the Government, and the Centre for Water Resources Development and Management is supported for carrying out research and training programmes on various aspects of water.

- .Realizing the need for more specific legislation for water resources management, the State Government has taken certain steps in this direction.

- Certain organizational and procedural changes have been introduced in the relevant Government departments and organizations to address the interstate water issues.

- .The Government has taken initiative to establish a River Authority for the Periyar river basin, recognizing the need for integrated river basin management.

- Several steps have been taken with a view to efficiently make use of the created water potential through modernisation, renovation and people's participation.

- Keeping in view the optimal utilisation of the water resources of Kerala, several projects have been formulated by the user departments and organizations covering a wide range of sectors such as drinking water, industrial, irrigation, hydroelectric power, inland navigation, fisheries, and hydro-tourism and water sports.

- The rural population and the panchayats are supported by the Government to take up projects based on traditional water sources.

- The different departments and organizations of the Government are carrying out integrated watershed management projects with due stress on soil and water conservation.

- All these ventures of the Government of Kerala are expected to set the trend for the water management in the next millennium.

7.6 Problems and Issues Related to Irrigation Sector

Report of the Working Group on 'Water Resources & Environment - Approach, Policies and Reforms' State Planning Board Thiruvananthapuram May 2003, Government of

Kerala Tenth Five Year Plan 2002-07 has cited the following problems and reforms/recommendations related to the irrigation sector.

7.6.1 Problems

- Non-availability of reliable and comprehensive hydrological data.
- Unscientific way of project preparation.
- Inadequate provision and delay in getting the funds.
- Delay in completion of projects resulting in time and cost overrun.
- Lack of proper maintenance of the existing major and minor irrigation systems leading to reduction in carrying capacity.
- Poor collection of cess.
- Lack of participatory irrigation management affects the optimum utilization of the potential created.
- Inadequate institutional arrangement for PIM.
- Poor linkage with CADA, lack of coordination among the related departments
- Reclamation of wetlands.
- Poor R&D facilities.
- Indiscriminate construction of river protection barriers.
- Blockage of drainage through construction of roads.
- Deforestation of catchment areas.
- Non-availability of modern geophysical and latest Landsat Imageries in relation to ground water.
- Lack of base maps in detail for planning and management of groundwater extraction structures, recharging structures and implementation of rainwater harvesting techniques.
- Delay in implementation of Groundwater Bill for Control and Regulation of Groundwater in notified areas/critical/ over exploited areas as per GEC norms.
- Intervention of unscientific private drilling which leads to groundwater depletion and interference of wells.
- Unscientific approach to groundwater management.
- Delay in availability and consent from the public for various recharge structures.
- Lack of a model for future planning in relation to the actual field situation.
- Non-availability of dismantling type of rigs with high-pressure compressors for competing with the private agencies and speedy implementation of the works at the department level.
- Lack of research oriented works for finding out solutions in the problematic areas.

7.6.2 Reforms/Recommendations

- Updating of data base in the irrigation sector.
- Formation of River Basin Organizations with a multidisciplinary approach.

- Implementation of State Water Policy and Enactment of Irrigation Bill
  Formation of the Department of Water Resources bringing the water related disciplines under one fold.
- Pricing of water to cover operation and maintenance of the infrastructure created under irrigation.
- The supply oriented distribution may be converted to demand oriented one.
- Awareness programme for PIM.
- Promotion of indigenous and traditional water technology and water management practices such as pond/tank, streams, irrigation which were neglected due to introduction of modern technology.
- Thrust on recharging, and conservation of ground water.
- Need for a regulatory act to control the unbridled exploitation of ground water.
- Formation of an autonomous, self supporting highly competent investigation organization responsible for investigation project preparation and providing consultancy services to the Panchayat Raj Institutions (PRIs)
- Formation of high level committee for monitoring and concurrent evaluation of the progress of implementation of the project for time bound completion.
- Strengthening the monitoring and evaluation system.
- Strengthening the R&D support.
- Modernisation of the designing activities and project management by appropriate use of technology and human resource development
  Introduction of responsible methods of project management and inbuilt mechanisms for timely completion of projects
- Demystification of project conception and implementation

7.7 Estimation of Gap between Irrigation Potential Created and Utilized (Kerala)

Data was collected, through a structured and pre tested questionnaire, from a total of 500 farmers, covering Major, Medium and Minor irrigation schemes in Kerala. To make the sample representative, to the extent possible, of the entire state, a total of 9 districts were covered under the survey. Totally 57 villages were covered across the three types of irrigation schemes. Special efforts were made, while selecting the villages, to provide adequate representation to the farmers in the head reach, mid reach and tail reach. The details of sample selected under major, medium and minor projects and comprehensive analysis of primary survey data analysis is presented in Annexure 9.

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation

at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project
- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers.

Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach is also identified. In addition, the area of the sample farmers under major, medium and minor irrigation schemes is also identified. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 1014.58 acres. Of this area, 95.92 acres are in the head reach, 276.10 acres are in the mid reach and another 415.73 acres are in the tail reach. Similarly, 378.17 acres are under major

irrigation projects, 409.58 acres are under medium irrigation projects and the remaining 226.83 acres are under minor irrigation projects (Table 7.5).

Table 7.5 Area under Irrigated Crops (acres)

Irrigated Owned						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
A1 Project Name	Major	20.09	153.45	170.01	.	343.55
	Medium	75.16	94.70	228.10	.	397.96
	Minor	.	.	.	203.18	203.18
Total		95.25	248.15	398.11	203.18	944.69
Irrigated Area Leased IN						
		2006-07				
		H	**M**	**T**	**Minor**	
A1 Project Name	Major	0.05	18.75	19.12	.	37.92
	Medium	0.62	11.00	0.00	.	11.62
	Minor	.	.	.	26.65	26.65
Total		0.67	29.75	19.12	26.65	76.19
Irrigated Area Leased Out						
		2006-07				
		H	**M**	**T**	**Minor**	
A1 Project Name	Major	0.00	1.80	1.50	.	3.30
	Medium	0.00	0.00	0.00	.	0.00
	Minor	.	.	.	3.00	3.00
Total		0.00	1.80	1.50	3.00	6.30
Total Irrigated Area						
		2006-07				
		H	**M**	**T**	**Minor**	
A1 Project Name	Major	20.14	170.40	187.63		378.17
	Medium	75.78	105.70	228.10		409.58
	Minor				226.83	226.83
Total		95.92	276.10	415.73	226.83	1014.58

In the year 2006-07, the gap is the highest under the major irrigation schemes in Kharif seasons. On the other hand, the gap is highest under the minor irrigation schemes in the Rabi season. While the overall gap is 12.90 percent in Kharif season, it is marginally more at 15.54 percent in the Rabi season. It is possible that the heavy monsoons in Kerala could have contributed to low percentage of the gap. Unfortunately, there was no information or data from the state department of irrigation and hence the gap is calculated

to provide an indication of the irrigation potential created and utilized. One of the interesting aspects of Kerala state is that the area utilized for irrigated under the medium projects in kharif season is more than the irrigation potential created. This could be due to additional area irrigated by the sample farmers by using the irrigation water as well as monsoon rains judiciously. Similarly, the area utilized in the mid reaches of major and medium projects in Rabi season is more than the potential created. Area under Irrigated Crops (acres) and Gap between Irrigation Potential created and Utilized (based on data from Sample farmers) are presented in Table 7.6

Table 7.6 Area under Irrigated Crops (acres) and Gap (percentage

Kharif							
		2006-07					
		H	**M**	**T**	**Minor**	**Total**	**Gap (%)**
A1 Project Name	**Major**	15.32	123.60	124.88		263.80	30.24
	Medium	72.11	99.34	240.81		412.26	-0.65
	Minor				207.66	207.66	8.45
Total		87.43	222.94	365.69	207.66	883.72	12.90
		8.85	19.25	12.04	8.45	12.90	
Rabi							
		2006-07					
		H	**M**	**T**	**Minor**		
A1 Project Name	**Major**	10.65	192.07	145.45		348.17	7.93
	Medium	84.89	111.13	219.91		415.93	-1.55
	Minor				92.82	92.82	59.08
Total		95.54	303.20	365.36	92.82	856.92	15.54
		0.40	-9.82	12.12	59.08	15.54	
Summer							
		2006-07					
		H	**M**	**T**	**Minor**		
A1 Project Name	**Major**	8.15	108.13	101.04		217.32	42.53
	Medium	13.35	34.39	28.61		76.35	81.36
	Minor				67.42	67.42	70.28
Total		21.50	142.52	129.65	67.42	361.09	64.41
		77.59	48.38	68.81	70.28	64.41	

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them (Table 7.7).

Table 7.7 Limits of Gap Based On Survey Data Analysis

Category	No of sample farmers	Kharif			Rabi			Summer		
		Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit
Major	233	30.24	24.35	36.14	60.17	53.88	53.88	42.53	36.19	48.88
Medium	152	-0.65			58.64	50.81	50.81	81.36	75.17	87.55
Minor	115	8.45	3.37	13.54	59.81	50.85	68.77	70.28	61.92	78.63
Head	47	87.43	77.95	96.91	0.40	-1.40	2.19	77.59	65.66	89.51
Mid	156	19.25	13.07	25.44	-9.82			48.38	40.54	56.22
Tail	182	12.04	7.31	16.76	12.12	7.38	16.86	68.81	62.08	75.54
Total	500	12.90	9.96	15.84	15.54	12.36	18.71	64.41	60.21	68.61

7.8 Summary and Conclusions

The study team could not get any detailed data project wise from the state. However, they helped us in conducting the PRA and some useful information is obtained through this work shop. These details are discussed along with PRA workshops held at Hyderabad and Bangalore in a subsequent chapter. A detailed note on irrigation sector and recent trends are discussed in the beginning of this chapter. This is base on the reports made available and discussions with various officials from the department. On the basis of data supplied by them the following observations could be made:

- Percentage utilization of major/medium projects on an average works out about 92%; thus the gap is to the extent of mere 8percent
- In the case of minor irrigation the percentage utilization is about 93.5% giving rise to a gap of about 6.5 percent
- At the same time the data provided on minor irrigation projects for five years starting from 2001-02 indicate a wide variation. Two years there is a gap of the

order of 33 and 28 percent; while for three years the data indicates excess irrigation of 725 percent. This clearly brings these projects are rain fall dependant to a large extent.

- The department has undertaken a review of the gap due to changes in the cropping pattern in the command area district wise.. The analysis shows there are gaps due to changes in the cropping pattern and the maximum gap is in the district of Kollam and is about 63 percent; while the minimum reported is 11 percent in the district of Mallapuram.

The following conclusions could be made based on primary data analysis :

- Under major projects the gap for Kharif is 30.74 percent where is in Rabi it is much less at 8 percent only.
- It is interesting to note that there is no gap in medium irrigation projects either for Rabi or Kharif season
- The gap in the case of minor irrigation varies from 8 percent for Kharif and 59 percent for Rabi.
- The same information viewed differently from the point of location of the area (Head, Middle and Tail) the gap varies widely. It is interesting to note that middle reach farmers suffer with higher percentage of gap compared to tail enders during Khariff and gap is negligible in Rabi for head and middle reach.
- However the gap is much high during summer season which is expected.

CHAPTER 8

MAHARASHTRA

CHAPTER 8
MAHARASHTA

8.0 Secondary data provided on irrigation projects

Data provided by the department for the selected projects is analyzed separately for Major, Medium and Minor Projects and the same is presented below.

Major Irrigation

1. Nira

The project is constructed across Nira River, Bhima river basin in Purandar taluk, Pune district. It was completed in 1965 benefiting Satara and Solapur districts in Maharashtra. The total yield envisaged in the project proposal 996 Mm^3 and 991 Mm^3 are meant for irrigation purpose. The yield envisaged in the project proposal is realised 41 times upto 2002. The irrigation potential created is for 65,505 Ha. The present cropping pattern under this command area is 8097 ha. Kharif, 27530 ha. Rabi, 100081 ha Summer, 10526 ha two seasonal crop and 9271 ha perennial crops.

Presently the season wise utilisation of irrigation water ratios are 38% for kharif crops, 39% for rabi crops and 23% for summer crops under the project as presented in table 8.1

Table 8.1 Cropping Pattern Under the NIRA RBC Project Over the Period 2002-03 to 2006-07

Year	ICA (Ha).	Sown area in the command (Ha)					
		Kharif season		Rabi season		Hot weather season	
		Area	% to ICA	Area	% to ICA	Area	% to ICA
2002-03	65,506	48,263	73.68	55,018	83.99	23,370	35.68
2003-04	65,506	47,835	73.02	52,588	80.28	13,019	19.87
2004-05	65,506	39,523	60.33	64,380	98.28	33,739	51.51
2005-06	65,506	42,365	64.67	70,152	107.09	35,320	53.92
2006-07	65,506	51,767	79.03	72,081	110.04	49,077	74.92

Note: Area shown above in each season includes perennial crops in that season.

Distributory-wise data on potential created, potential utilized and the cropping pattern under the command area for the reference period is available.

2. Upper Wardha

It benefits Amaravati and Wardha districts. Total yield envisaged in the project proposal is 485.75 Mm3 for irrigation purpose only and 8 times out of 12 years the yield is realised as per project report upto 2002. Only 11% of irrigation water could be supplied out of the potential supply and benefiting only 7% of area irrigated through one of the distributory providing irrigation water to the tail end command area.

3. Jayakwadi

It is a dam across Godavari River near Paithan in Aurangabad district. It benefits Aurangabad, Jana, Beed, Parbhani and Ahmedabad districts. The project was completed in 1976 with a total yield envisaged in the project proposal being 2058.88 Mm3. The allocation for irrigation is 1394.05 Mm3. The quantum envisaged in the project report has been realized 7 times (0-25%), 8 times (25-50%), 5 times (50-75%) and 12 times (100%) in 32 years up to 2006. During years 2005-06 and 2006-07 the percentage of irrigation utilization is 33.54% and 21.04% respectively. The field officer's reasons in terms of weights assigned (0-100%) are presented in table 8.2 and 8.3. It is evident that the tail end areas suffer more compared to the head reach areas whenever monsoon is not normal in the region.

Table 8.2 Utilization of Irrigation Potential Created Cropping Pattern Under the Project Over The Period 2002-03 to 2006-07

Year	ICA (Ha)	Kharif Season		Rabi Season		Hot weather Season		Total cropped Area	Yield received in mm3	Total utilization	% of utilization over total yield
		Irrigated area (Ha)	% to ICA	Irrigated area (Ha)	% to ICA	Irrigated area (Ha)	% to ICA				
2002-03	183,322	118,383	64.57	110693	60.38	1,592	0.86	230,668	408.49	408.28	99.95
2003-04	183,322	131,405	71.68	126935	69.24	687	0.37	259,027	558.86	452.07	80.89
2004-05	183,322	118,019	64.37	119778	65.33	83,119	45.34	320,916	2235.59	1360.89	60.87
2005-06	183,322	123,292	67.25	106363	58.01	37,328	20.36	266,983	4590.00	1539.64	33.54
2006-07	183,322	138,863	75.74	119233	65.04	34,460	18.79	292,556	7889.00	1659.46	21.04

Table 8.3 Reasons For The Gap Between The Irrigation Potential Created And

Season and Reach wise reasons (weighted in percentages) for the gap in 2006-07						
Reasons	**Kharif**			**Rabi**		
	Head reach	**Middle reach**	**Tail end**	**Head reach**	**Middle reach**	**Tail end**
1. Good rainfall in command	25	25	95	15	15	100
2. Loss of water due to damaged/non-existing gates	5	5	5	5	5	
3. Non execution or damaged field channels	18	18		20	20	
4. Canal carrying capacity less than design capacity	10	10		10	10	
5. Poor condition of canal - damage condition	10	10		10	10	
6 .Poor condition of canal - due to silting	12	12		20	20	
7. Poor condition of canal - weed growth	10	10		10	10	
8. Poor condition of canal - damage condition	5	5		5	5	
9. Poor condition of canal - canal breach	3	3		3	3	
10. Social reasons	2	2		2	2	

Medium Irrigation

1. Morna

Located at Pastual village in Patur taluk, the medium irrigation project benefits the Akola district and the created command area is 6532 Ha and the irrigation potential is for 5168 ha. The total planned water utilization in project is 47.23 Mm3. The full yield is realised 11 times in 32 years as per the project report.

The cropping pattern under the project is kharif (620 ha), rabi (3617 ha), hot weather (517 ha) and perinial (414 ha) accounting 5168 ha of irrigated area in this project. Irrigation water usage during three seasons is kharif (27%), rabi (27%) and summer (33%).

2. Girija project

Located at Yesgaon, Khultabad Taluk in Aurangabad district, the total yield envisaged in the project proposal is 24.26 Mm3. The irrigation potential created is 3447 ha The potential yield has been realised only 6 times out of 16 years of its completion. The yield is realized partially 8 times (0-25%), 2 times (25-50%), and 4 times (50-75%).

The gap between the irrigation potential created and utilized is varying as a result of reduction in rain fall as given in the table 8.4

Table 8.4. Quantum of Water Availability over the Period

Year	Available water (MC3) for utilization
2002-03	15.55
2003-04	7.62
2004-05	1.41
2005-06	1.41
2006-07	21.23
Expected Yield	24.26

3. Waghad

The created command area is 9642 ha and irrigation potential is 6750 ha. Full yield of 72.30 MC3 is realised 17 times out of 26 years span. 50-75% of yield is realised in 9 years as per the project proposal report. 36% of area under kharif crops and 64% of area under two seasonal crops are provided irrigation. 7.44 MC3 of water is utilized for kharif season and 57.21 MC3 of water for rabi season. Table 8.5 gives the season wise areas sown in the command area

Table 8.5 Season Wise Areas Sown in the Command Area

Sown Area in the command in different seasons								
Sr.No	Year	ICA(Ha)	Kharif Season		Rabi Season		Hot Weather Season	
			Area	% to ICA	Area	% to ICA	Area	% to ICA
1	2002-03	6750	1451	21.49	5428	80.41	2253	33.37
2	2003-04	6750	1567	23.29	3454	51.17	2356	34.90
3	2004-05	6750	1628	24.11	3956	58.60	2809	41.61
4	2005-06	6750	1760	26.07	4784	70.87	2709	40.13
5	2006-07	6750	2401	35.57	5305	78.59	3194	47.31

Main reasons for gap in irrigation potential created and utilisation as per field officers views are

Kharif season

- Shortage of rainfall in command areas (75%)
- Social reasons (25%)

Rabi season:

- In adequate storage/yield
- Loss of water due to damaged / non existing gate
- Loss of command area due to non-agricultural land use
- None execution or damaged field channels

4. Bassapachi Wadi

Located at Sangli taluk, the medium irrigation project is planned to benefit Sangli district. Created command area, irrigated command area and irrigation potential are 1077 ha, 862 ha and 942 ha respectively. Planned water utilisation in project is 4.341 Mm^3. Since its completion in 1980, the full is not realised at any time. Inadequate storage and yield are the main reasons for the existence of wide gap here.

5. Chargoan

This medium irrigation project is located at Chargaon in Warora taluk, Chandraput district.

The irrigation potential created is for 2120 ha with 21.78 Mm3 of envisaged quantum of water under the project. The project has realized the envisaged quantum as per the project report in 27 years out of 30 years period. Table 8.6 and 8.7 present the details of the analysis.

1. Loss of water due to damaged/ non-existing gates
2. Reluctance of farmer to irrigation
3. Poor condition of canal (Damage condition, due to silting, weed growth and damaged structure)

Table 8.6 Season Wise Areas Sown in the Command Area

Sr. No.	Year	ICA (Ha).	Sown area (Ha) and % to ICA					
			Kharif		Rabi		Total	
			Area	% to ICA	Area	% to ICA	Area	% to ICA
1	2002-03	1570	922	58.73	769	48.98	1691	107.71
2	2003-04	1570	894	56.94	949	60.45	1843	117.39
3	2004-05	1570	935	59.55	790	50.32	1725	109.87
4	2005-06	1570	916	58.34	1043	66.43	1959	124.78
5	2006-07	1570	924	58.85	1150	73.25	2074	132.10

Table 8.7 Details of Selected Distributory Segments (Head, Middle And Tail End Reach) in Respect of Irrigation Distribution and Cropped Area.

Canal Reach	Year	Planned (as per Project Report)		Actual Utilization		
		Quantum to be supplied (Mm3)	Area to be irrigated (Ha)	Quantum supplied (Mm3)	Area Irrigated (Ha)	% of acreage irrigated to potential created
Head	2002-03	3.56	630	7.21	642	101.90
	2003-04	3.56	630	5.57	665	105.56
	2004-05	3.56	630	5.81	760	120.63
	2005-06	3.56	630	7.20	818	129.84
	2006-07	3.56	630	7.60	800	126.98
Middle						
	2002-03	3.67	650	5.70	545	83.85
	2003-04	3.67	650	4.70	567	87.23
	2004-05	3.67	650	3.50	491	75.54
	2005-06	3.67	650	4.80	577	88.77
	2006-07	3.67	650	4.50	695	106.92
Tail end						
	2002-03	4.75	840	5.15	504	60.00
	2003-04	4.75	840	5.36	611	72.74
	2004-05	4.75	840	3.00	474	56.43
	2005-06	4.75	840	4.23	564	67.14
	2006-07	4.75	840	4.34	579	68.93

6. Natuwadi

The project is located at Natuwadi in Khed taluk, Ratnagiri district and benefits Ratnagari district to the extent of 2050 ha of command area with 27.87 Mm^3 quantum of water. This project has realized the yield as per the project report for all the years. The quantum of water for irrigation purpose is 26.040 Mm^3.

There is no shortage of water to the main canal system under the project. Inadequate rainfall is shown as the main reason (90%) for not taking up kharif crops in the command area. Only rabi crops are grown as shown in the table below. There is wide gap between the irrigation potential created and utilized over these years as given in table 8.8.

The reasons for these gaps are 1. Loss of command area due to non agriculture land use (20%), 2. Reluctance of farmers to irrigation (50%) and 3. Non-execution or damaged field channels as part of CAD works (5%).

To analyze further one of distributories (middle reach Dy1) data is presented in table 8.9. The wide gaps in terms of water supplied and area irrigated over the reference period exist under the project.

The canal system consists of 1) LBC up to 12 Km and Branches (irrigation potential created of 280 ha), 2) RBC up to 24 Km (965 ha), 3) Dy1 – 8.0 Km (400 ha) and 4.Dy2 – 4.0 Km (405 ha)

Table 8.8 Percentage of Gap between the Irrigation Potential Created and Utilized

Year	Potential created (Ha)	Area Irrigated (Ha) during rabi season	% of gap to total potential created
2002-03	2050	132.00	93.56
2003-04	2050	157.25	92.33
2004-05	2050	180.00	91.22
2005-06	2050	14.00	99.32
2006-07	2050	198.90	90.30

Table 8.9 Performance of A Distributory (Middle Reach) Under the Project.

Name of the Distributory	Canel Reach	Year	Planned (As per project Report)		Actual Utilization		% of supply over planned	% of irrigated area over planned
			Quantum to be supplied (MM3)	Potential Created (Ha)	Quantum Supplied (MM3)	Area irrigated (Ha)		
DY-1(Middle Reach)	Middle	2002-03	5.08	400	0.200	8.40	3.94	2.10
		2003-04	5.08	400	0.356	13.30	7.01	3.33
		2004-05	5.08	400	0.566	11.35	11.14	2.84
		2005-06	5.08	400	0.011	0.45	0.22	0.11
		2006-07	5.08	400	0.815	8.15	16.04	2.04

Minor Irrigation

1. Marsul

The project benefits Hingoli and Parbhani districts. The potential created is for 345 ha and the cropping pattern under this irrigated area is kharif (23%) and rabi two seasonal (77%) crops.

Out of 3.006 Mm^3 of potential created under this scheme 2.406 Mm^3 of water is utlised for irrigation purpose. Presently 20% of the water resource is used for karif kharif and 80% for rabi two seasonal crop The envisaged yield is realised 6 times out of 9 years since creation of full storage.

2. Bhurikawathe

The minor irrigation project is located in Akkalakot taluk, Solapur district. Solar district is benefited with 1.25 Mm^3 of water supply to irrigate 232 ha of command area (Created command area is 372 ha). 8 times in a span of 15 years (up to 2006), the yield is realized fully.

Supply of water was possible in 2004-05 only to the extent of .06 Mm^3 to rabi crops (20 ha of irrigation) during the reference period from 2002-03 to 2006-07. The gap is nearly 100% during this period due to inadequate yield to the tank.

3. Shirwalwadi

The minor irrigation project is located in Akkalakot taluk, Solapur district. Solar district is benefited with 2.95 Mm3 of water supply to irrigate 485 ha of command area (Created command area is 607 ha). 15 times in a span of 26 years up to 2006, the yield as envisaged in the project report is realized fully.

The reduction in rainfall and bad condition of channels and silting are the cited reasons for the gap between the potential created and utilized in the command area. Table 8.10 gives the season wise irrigated areas under the project command area

Table 8.10 Season Wise Irrigated Areas under the Project Command Area

Sl. No.	Year	ICA (Ha)	Season wise irrigated area under the project					
			Kharif		Rabi		Hot weather	
			Area	% to ICA	Area	% to ICA	Area	% to ICA
1	2002-03	485	0	0	0	0	0	0
2	2003-04	485	0	0	0	0	0	0
3	2004-05	485	0	0	74	15.25	0	0
4	2005-06	485	0	0	62	12.78	0	0
5	2006-07	485	0	0	31	6.39	0	0

4. Pabhare

The project is at Khindwadi in Mahad taluk ,Raigad district with 125 ha irrigation potential and 1.847 Mm^3 quantum of water. The yield has been realized fully all these years as per the project report. There is a gap of 42-48% in kharif season. However during 2006-07, the gap is reduced to 8% if the total area irrigated during kharif and rabi seasons are taken together as shown in table 8.11. Since it is a minor irrigation project, the cropping pattern adopted and the willingness of the farmer to irrigate crops in rabi season will have bearing on the gap Reasons for the gap are presented in table 8.12 as observed by the field officer in the command.

Table 8.11 Percentage of Irrigated Area over the Potential Created Over the Reference Period

Year	ICA (Ha)	Sown area in the command (Ha)					
		Kharif season		Rabi season		Hot weather season	
		Area	% of ICA	Area	% of ICA	Area	% of ICA
2002-03	125	67.21	53.76	0.00	0	13.06	10.44
2003-04	125	65.11	52.08	0.00	0	1.40	1.12
2004-05	125	69.27	55.41	0.00	0	3.32	2.65
2005-06	125	72.13	57.70	0.00	0	3.00	2.40
2006-07	125	68.26	54.60	0.00	0	46.00	36.80

Table 8.12 Reasons for the Gap

Reason	Kharif			Rabi		
	Head reach	Middle reach	Tail end	Head reach	Middle reach	Tail end
1) Good rainfall in command	100	100	100	0	0	0
2) Loss of water due to damaged/ non existing gate				10	10	10
3) Faulty potential declaration				10	10	10
4) Reluctance of farmer to irrigation				60	60	60
5) Faulty project planning with respect to potential envisaged in each season				3	3	3
6) Poor condition of canal				12	12	12
7) Social reasons				5	5	5

8.1 Estimation of Gap between Irrigation Potential Created and Utilized (Maharashtra)

Data was collected, through a structured and pre tested questionnaire, from a total of 500 farmers, covering Major, Medium and Minor irrigation schemes in Maharashtra. To make the sample representative, to the extent possible, of the entire state, a total of 14 districts were covered under the survey. Totally 58 villages were covered across the three types of irrigation schemes. Special efforts were made, while selecting the villages, to provide adequate representation to the farmers in the head reach, mid reach and tail reach. The

details of sample selected under major, medium and minor projects and comprehensive analysis of primary survey data analysis is presented in Annexure 10.

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project
- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers.

Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach is also identified. In addition, the area of the sample farmers under major, medium and minor irrigation schemes is also identified. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated

area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 1972.50 acres. Of this area, 589 acres are in the head reach, 692 acres are in the mid reach and another 176 acres are in the tail reach. Similarly, 861.50 acres are under major irrigation projects, 595.50 acres are under medium irrigation projects and the remaining 515.50 acres are under minor irrigation projects The details are provided in Table 8.13.

Table 8.13 Area under Irrigated Crops (acres)

Owned						
		2006-07				
		H	**M**	**T**	**Minor**	**Total**
Category	**Major**	519.00	188.50	144.00	.	851.50
	Medium	60.00	503.50	32.00	.	595.50
	Minor	.	.	.	513.25	513.25
Total		579.00	692.00	176.00	513.25	1960.25
Leased IN						
		2006-07				
		H	**M**	**T**	**Minor**	
Category	**Major**	10.00	0.00	0.00	.	10.00
	Medium	0.00	0.00	0.00	.	0.00
	Minor	.	.	.	2.25	2.25
Total		10.00	0.00	0.00	2.25	12.25
Total Irrigated Area						
		2006-07				
		H	**M**	**T**	**Minor**	
Category	**Major**	529.00	188.50	144.00		861.50
	Medium	60.00	503.50	32.00		595.50
	Minor				515.50	515.50
Total		589.00	692.00	176.00	515.50	1972.50

In the year 2006-07, the gap is the highest under the medium irrigation schemes in Kharif season. On the other hand, the gap is highest under minor irrigation schemes in Rabi season. While the overall gap is as high as 19.82 percent in Kharif season, it is more than 52 percent in the Rabi season. It is possible that the projects under study are actually meant for providing irrigation water only in the kharif season and hence it may not be relevant to calculate the gap for rabi season. At the same time it is also possible that the

projects under study are meant for providing complete or partial irrigation in the rabi season in which case the gap is to be calculated in order to get the complete picture. Unfortunately, there was no information or data from the state department of irrigation and hence there the gap is calculated to provide an indication of the irrigation potential created and utilized. One of the interesting aspects of Maharashtra state is that the farmers in the tail reaches are not getting adequate supply of water, especially under the major irrigation schemes. The gap in the tail reaches is to the extent of 58 percent where as the corresponding percentage in the head reaches is only 0.30 percent. This indicates a very large inequality between the head reaches and tail reaches. The details are given in Table 8.14.

Table 8.14 Area under Irrigated Crops (Acres) and Gap (Percentage)

Kharif							
		2006-07					
		H	**M**	**T**	**Minor**	**Total**	**Gap (%)**
Category	**Major**	570.25	117.00	65.25	.	752.50	12.65
	Medium	17.00	347.00	9.00	.	373.00	37.36
	Minor	.	.	.	456.00	456.00	11.54
Total		587.25	464.00	74.25	456.00	1581.50	19.82
Gap (Percentage)		0.30	32.95	57.81	11.54	19.82	
Rabi							
		2006-07					
		H	**M**	**T**	**Minor**	**Total**	**Gap (%)**
Category	**Major**	309.50	110.00	51.50	.	471.00	45.33
	Medium	12.50	239.50	15.00	.	267.00	55.16
	Minor	.	.	.	191.75	191.75	62.80
Total		322.00	349.50	66.50	191.75	929.75	52.86
		45.33	49.49	62.22	62.80	52.86	
Summer							
		2006-07					
		H	**M**	**T**	**Minor**	**Total**	**Gap (%)**
Category	**Major**	13.00	21.25	21.00	.	55.25	93.59
	Medium	0.00	16.75	0.00	.	16.75	97.19
	Minor	.	.	.	0.50	0.50	99.90
Total		13.00	38.00	21.00	0.50	72.50	96.32
		97.79	94.51	88.07	99.90	96.32	

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them.

Table 8.15 Limits of Gap Based On Survey Data Analysis

Category	No of sample farmers	Kharif			Rabi			Summer		
		Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit
Major	200	12.65	8.04	17.26	45.33	38.43	52.23	93.59	90.19	96.98
Medium	136	37.36	29.23	45.49	55.16	46.81	63.52	97.19	94.41	99.97
Minor	118	11.54	5.78	17.31	62.80	54.08	71.52	99.90	99.34	100.00
Head	111	0.30	-0.72	1.31	45.33	36.07	54.59	97.79	95.06	100.00
Mid	176	32.95	26.00	39.89	49.49	42.11	56.88	94.51	91.14	97.87
Tail	49	57.81	43.98	71.64	62.22	48.64	75.79	88.07	78.99	97.14
Total	454	19.82	16.16	23.49	52.86	48.27	57.46	96.32	94.59	98.06

8.2 Summary and Conclusions

There are several observations from this chapter. While there is no question about the presence of a gap between irrigation potential created and utilized, trying to figure out the exact size of this gap and the reasons thereof are riddled with a number of problems. However, Maharashtra is one state which had undertaken a comprehensive analysis reasons for and quantified the gap by each factor. The major reasons for gap in Major/Medium Irrigation Projects include:

- Good rainfall in command Area
- Loss of water due to damaged/ non-existing gates
- Non execution or damaged field channels
- Canal carrying capacity less than design capacity
- Poor condition of canal – damage condition

- Poor condition of canal – due to silting
- Poor condition of canal – weed growth
- Poor condition of canal – damage condition
- Poor condition of canal – canal breach and
- Social reasons

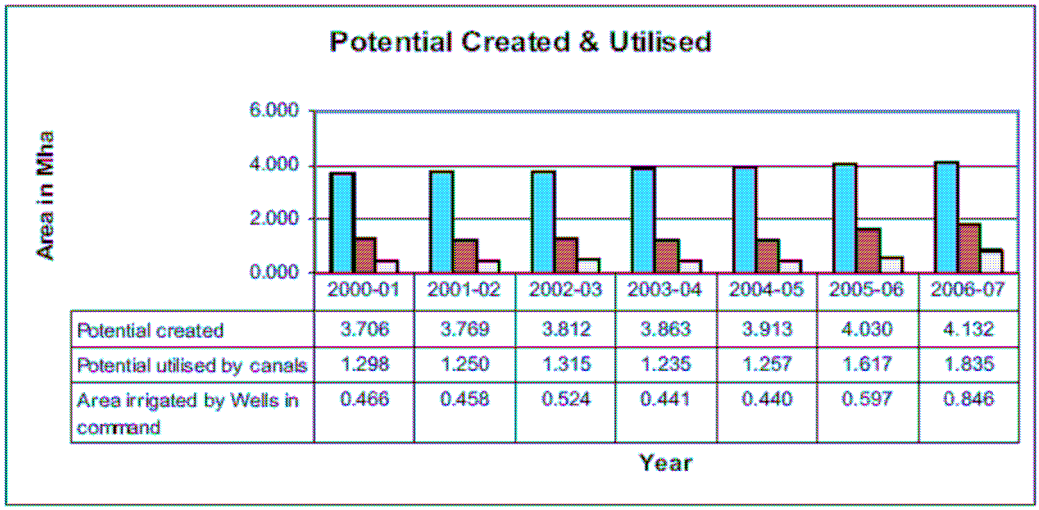
The predominant reasons for minor Irrigation Projects are

- Good Rain fall in Command Area
- Loss of water due to damaged/ non existing gate
- Faulty Potential Declaration
- Reluctance of Farmers to Irrigation
- Faulty Project Planning with respect to potential envisaged in each season
- Poor conditions of canal and
- Social Reasons

There are other general issues such as a) Difficulties in setting up of Water User Associations and problems in the functioning of many existing water users associations b) non-adherence to cropping pattern originally envisaged and, c) technical problems, particularly lack of proper maintenance at the canal level due to insufficient funds.The computation of gap from primary data reveal that gap in the major/medium projects varies from a high of 17.26 and low of 8.04 in percentage terms for Kharif Season. The gap is much higher in Rabi and varies from 38.43 to 52.23 percent. The Gap for summer crops is above 90 percent. However, one noticeable feature is that gap is much higher in tail end compared to middle reach and head reach. This is partly attributed to upper reach farmers are not allowing the water to tail end users as well problems of canal maintenance. The gap is more in the medium projects compared to Major and Minor Projects.What is not really clear is the gap statistics available at the national and how they got computed, whether they are weighted average of all the seasons or maximum reported in any one season. This study clearly brings out that there is wide variation between what is reported in national level statistics and field data both on the basis of selected projects secondary information and as per the primary survey analysis.

As per their latest annual report 2006-07, the present status of Irrigation utilization in the state is shown in figure 8.1

Figure 8.1 Irrigation details under major and medium projects



Inspire of initiating a number of steps to reduce the gap, the gap exists and the broad reasons are as follows as per the "**Report on benchmarking of irrigation projects in Maharashtra 2005-06 and 2006-07"-**

1. Low water yield in the reservoirs
2. Diversion of irrigation water to non-irrigation uses
3. Tendency of farmers to grow cash crops which are highly water intensive like sugarcane, banana
4. Low utilisation during kharif (Rainy) season
5. Reduction in storage capacity due to silting
6. Lapses in assessment of the irrigated area in the command
7. Non accounting of irrigated area outside the command (influence area)
8. Poor maintenance of the infrastructure due to financial constraints
9. Non participation of beneficiaries in irrigation management

CHAPTER 9

OTHER SMALL REGIONS IN THE STUDY AREA

CHAPTER 9
OTHER SMALL REGIONS IN THE STUDY AREA

The study area of IIMB includes many smaller regions such as Puducherry, Goa and Andaman Nicobar Islands. The analysis of these regions is presented below.

9.1 Puducherry

9.1.1 Secondary Data Provided On Irrigation Projects

The union territory of Puducherry consists of four regions viz., Puducherry, Karaikal, Mahe and Yanam. The geographical features of the union territory are not conducive for implementing major and medium irrigation projects under such circumstances. It can be seen the prevalence of minor irrigation system. Of the four regions of this union territory, intensive cultivation activities are being carried on in Puducherry, Karaikal and some extent in Yanam region adopting dual irrigation system under minor irrigation projects i.e., bore well irrigation (Ground water) and tank irrigation and canal irrigation (Surface water). Though the main source of water is ground water in Puducherry region, tank irrigation also prevails under 84 tanks with command area of 6278 hectare. These tanks are being maintained by the irrigation department are used for irrigation, pisiculture, maintaining of ecological balance and increasing the ground water potentiality.

The main sources of water for irrigation are canals and Ground water in this Union Territory. The irrigated areas in the regions of Puducherry are given in Table 9.1 and source of irrigation is given in Table 9.2

Table 9.1: Irrigated Area in The Regions

Region	Geographical area (Sq,Km)	Cropped area (Ha)	Irrigated area (Ha)
Puducherry	290	26,265	23,778
Karaikal	161	10,688	7,362
Yanam	20	1,162	603

Table 9.2: Irrigation System In Puducherry

Sources of water supply and area irrigated in the union territory					
	Area in hectares				
Source	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**
Net area irrigated by Canals	8133	7888	6380	316	6469
Net area irrigated by Tanks	0	0	0	0	0
Net area irrigated by Tube wells	13196	12929	12259	15026	11478
Net area irrigated by Other sources	61	55	55	2002	51
Total	21390	20872	18694	17344	17998
% of net area irrigated to net area sown	87.9	88.1	86.7	84	85.6
Area irrigated more than once in the same year	12756	12761	12533	14092	13793
Total irrigated area (gross)	34146	33633	31227	31436	31791
% of Total irrigated area (Grss) to total sown area	78.9	87.2	85.8	84.1	81.9

Source: Department of Economics and Statistics – season crop report 2004-05

9.1.2 Reasons for the gaps in the quantum of water supply and area irrigated

1. Shortage of rainfall is the main reason for the minor tanks – Bahour and Abhishegapalkkam not having sufficient water as envisaged in the project reports during the reference period.
2. The minor tank Kirumampakkam has encountered canal problems during 2004-05, 2005-06 and 2006-07.
3. The area irrigated has reduced under these tanks during this period.

Table 9.3 presents the details of the gaps in the quantum of water supply and area irrigated under minor irrigation tanks.

9.1.3 Estimation of Gap between Irrigation Potential Created and Utilized (Puducherry)

Data was collected, through a structured and pre tested questionnaire, from a total of 168 farmers, covering Minor irrigation schemes in Pondicherry. To make the sample representative, to the extent possible, of the entire state, one district was covered under the survey. Totally 10 villages were covered across the three types of irrigation schemes. Special efforts were made, while selecting the villages, to provide adequate

Table 9.3 Information on Minor Irrigation Tanks in Puducherry

Minor irrigation Tanks	Year	Quantum to be supplied (Mcft)	Area to be irrigated (Ha)	Quantum Supplied (Mcft)	Area irrigated (Ha)	% Gap in quantum of water	% Gap in Irrigated area
Kirumampakkam	2002-03	43.00	203.00	43.00	203.00	0.00	0.00
	2003-04	43.00	203.00	43.00	203.00	0.00	0.00
	2004-05	43.00	203.00	38.76	183.00	9.86	9.85
	2005-06	43.00	203.00	34.95	165.00	18.72	18.72
	2006-07	43.00	203.00	31.77	150.00	26.12	26.11
Bahour	2002-03	193.00	728.98	57.43	216.35	70.24	70.32
	2003-04	193.00	728.98	63.48	239.15	67.11	67.19
	2004-05	193.00	728.98	193.46	728.82	-0.24	0.02
	2005-06	193.00	728.98	173.82	654.83	9.94	10.17
	2006-07	193.00	728.98	175.33	660.52	9.16	9.39
Abhishegapakkam	2002-03	53.00	308.00	40.00	146.00	24.53	52.60
	2003-04	53.00	308.00	46.00	200.00	13.21	35.06
	2004-05	53.00	308.00	47.00	210.00	11.32	31.82
	2005-06	53.00	308.00	45.00	190.00	15.09	38.31
	2006-07	53.00	308.00	40.00	150.00	24.53	51.30
Korkadu	2002-03	32.00	203.00	32.00	203.00	0.00	0.00
	2003-04	32.00	203.00	32.00	203.00	0.00	0.00
	2004-05	32.00	203.00	32.00	203.00	0.00	0.00
	2005-06	32.00	203.00	32.00	203.00	0.00	0.00
	2006-07	32.00	203.00	32.00	203.00	0.00	0.00

representation to the farmers in the head reach, mid reach and tail reach. The details of sample selected under major, medium and minor projects and comprehensive analysis of primary survey data analysis is presented in Annexure 11

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project
- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers.

Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach is also identified. In addition, the area of the sample farmers under major, medium and minor irrigation schemes is also identified. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 614.35 acres. The entire area available for irrigation with the sample farmers in Pondicherry is under minor irrigation schemes (table 9.4).

Table 9.4: Area (Ha) Owned By Farmers

Area Owned	589.85
Area Leased in	27.5
Area Leased out	3
Total Area Cultivated	614.35

In the year 2006-07, the gap is only 16 percent during the Kharif season. The gap had increased to about 28 percent in the Rabi and to 34 percent in summer season. The area irrigated in different seasons by the sample farmers in Pondicherry and the gap based on the total area available for irrigation with the sample farmers is presented in the table below.

Area under Irrigated Crops (acres) and Gap between Irrigation Potential created and Utilized (based on data from Sample farmers (Table 9.5)

Table 9.5: Area under Irrigated Crops

Season	Area Cultivated	Gap (%)
Kharif	514.6	16.24
Rabi	441	28.22
Summer	404	34.24

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them (Table 9.6)

Table 9.6: Limits of Gaps

	Lower Limit	Upper Limit
Kharif	10.65	21.83
Rabi	21.39	35.05
Summer	27.04	41.44

9.2 Andaman and Nicobar Islands

9.2.1 Secondary Data Provided On Irrigation Projects -

Around 9% of the total geographical area of the Islands accounts for agriculture and other activities. Out of the area under agriculture, 12000 ha are under rice cultivation, 28267 ha under plantation crops including coconut, areca nut, and rubber. Cultivable area ranges from 0-80.16%. in North Andaman and Car Nicobar and Katchal have over 40.05

% area under crops and rests of the islands have cultivable area between 0-19 percent. Out of 36 in habited islands 11 islands have no cultivable land and 14 have less than 10 percent area under cultivation.

Paddy is predominantly grown in Andaman group of islands and only North, Middle and South Andaman have more than 1000 ha area under paddy.

9.2.2 Type of Crops Grown

In Andaman and Nicobar Islands the total available land for Agriculture is limited to 50,000 ha. i.e. 6% of the total geographical area only. No further land is being released because of the prevailing ecological conditions. Due to rapid urbanization and growth of population in these Islands, arable land is shrinking while pressure on enhancing productivity is enormous. A strategy has been adopted to keep a balance among the various use of lands to increase production and productivity in a sustainable manner and efforts are being made to produce more per unit area by adopting multiple and intensive cropping system following the scientific management practices with utmost care of conserving soil and water. Further efforts are underway to utilize the vacant hilly land by promoting plantation, fruits and spices crops, which grow naturally well, out here.

Paddy is the main field crop of these Islands during Kharif season. Cultivation of paddy is spread over 8-10 Islands where settlement have been established. Paddy cultivation in Kharif is followed by cultivation of a second crop of paddy, oilseeds and pulses. Though the Islands fall under humid tropics with more than 3180 mm of rainfall annually, field crops like pulses, oilseeds have limited scope in these Islands owing to uncertain weather conditions.

9.2.3 Minor Irrigation Schemes in Andaman and Nicobar

To implement the project, series of check dams were constructed in some of the available streams in the Islands where water has been made available even in the dry spell (i.e from January to May). Formerly the water used to flow directly in to sea without any

obstruction. These obstacles in the shape of check dams are created in the streams will automatically prevent the runoff of rain water into the sea because velocity of the water will be reduced due to the series of check dams created in the streams. This mechanism will ultimately recharge the adjoining areas and increase the moisture content of the soil, simultaneously this will stop severe soil and stream bank erosion.

Therefore, to make the islands sustainable in agriculture various types of Minor Irrigation scheme are the only solution. Under the minor irrigation schemes check dams are constructed in the streams flowing in between the arable field of the farmers. Check dams have the following advantages for the farming community of A&N Islands.

1. Help in rainwater harvesting.
2. Recharging ground water.
3. Providing drinking water for human as well as consumption for cattle.
4. Irrigation of crops.
5. Prevent erosion of valuable soils and streams bank protection.
6. Reduce silt in the coral reefs areas thereby enhancing fisheries resources.

This will help to make the drainage system perennial through lot of water conservation and recharge along its course.

Under the Minor Irrigation schemes 101 Nos. check dams have been constructed so far till March' 2005. Thus an irrigation potential of 724.50 hectare have been created by the 101 Nos. check dams. All the check dams are constructed as per the technical guidelines given by Shri. A. Kar, Scientist 'D' (Geo-hydrologist) of Central Ground Water Board, Eastern Region, Kolkata. The check dams are designed by Shri. Sarbjit Singh, Assistant Engineer (MI) of the Department of Agriculture. The zone wise position of check dams constructed vis-à-vis irrigation potential created is as follows:-

\

Table 9.7 Irrigation System in the Region

Sl. No.	Zone	Numbers	Irrigation potential created (in ha.)
1.	South Andaman	69	485.00
2.	Middle Andaman	17	107.50
3.	Mayabunder	06	048.00
4.	Diglipur	09	084.00
Total		101	724.50

Out of the total geographical area of 8249 sq.km land, the land available for agriculture is only about 50,000 hectares , out of which land measuring an area of 4206 hectares have been totally submerged in Tsunami 0f 2004.

9.2.4 Minor Irrigation Projects

Two important projects, which are covered under the minor irrigation scheme, are the VNMI project scheme covering the Rabinbdra nagar village and the RKPUR Dam project scheme covering the RK PUR village. Both the projects are in the area called HUT BAY (250 km from Port Blair), which is in little Andaman. The agriculture department is carrying out various other projects for irrigation.

For the purpose of our study we collected details from the two minor irrigation projects from 21 farmers. In the RK PUR project scheme one main canal and 3 minor canals have been constructed for the purpose of irrigation.

The department of agriculture has provided the completed details of the irrigation potential created up to 31-7-08.

Table 9.8: Sources of Irrigation and Area Irrigated

Sl.No	Category	No	Rate	Hectares
1	Ponds	1368	0.6ha/pond	820.80
2	Wells	465	1.0ha/well	465.00
3	Pump set	910	2.0ha/well	1820.00
4	Check dams	103	5.0ha/dam	515.00
			Total	3620.80

Irrigation potential created in the R.K PUR Dam region and VNMI dam region

Both the dams were constructed for the purpose of minor irrigation in little Andaman and Nicobar Islands **R.K PUR dam (Rama Krishnapur minor irrigation scheme)** – dams were created in order to store water for irrigation. The length of the main canal is 640 meter, the length of the 3 minor canals is 4800 meters, the length of the sub minor canal is 620 meters, the irrigational storage is 41.50 – 38.90 –2.60 meters, the extent of usable storage is 190 meters, The area under irrigation in this scheme is 350 hectares

Details of the VNMI dam (Vishnu nallah minor irrigation scheme) - The length of the main canal is 6095 meters, the length of the 3 minor canals is 3915 meters, the length of the sub minor canal is 625 meters, the irrigational storage is 4.30meters, the extent of usable storage is 141.80 meters. The area under irrigation in this scheme is 350 hectares.

Crop pattern in the dam sites of VNMI AND RK PUR

The cultivation in these two site regions ahs been largely plantation – black pepper is cultivated followed by coconut and arecanut and vegetables. The sample farmers also confirmed that paddy and banana cultivation is less.

9.2.5 Primary Data Analysis

Sample Profile

Out of 21 farmers surveyed, 7 farmers are in the age group of 31-40, 7 in the age group above 50 years, 5 farmers in the age group of 41-50 years and 2 farmers were in the age group of 21-30. 20 farmers come under the category of others and 1 was an OBC. 15 farmers have attended till junior school, 4 till high school and 1 each a post graduate and an illiterate.

18 respondents are farmers and agriculture is the primary occupation. 15 farmers are able to generate an yearly income of Rs 50,000 to Rs 1,00,000 and 2 farmers earn up to 2,00,000 per annum. Only 1 farmer has an open well as an alternate source for water generation

Present Status of the Schemes

Land topography is uneven; hence surface flow of water is not possible. In most of the places lift irrigation is practiced. Irrigation department has not created any alternate sources of water for agriculture. This work has been carried out by the agriculture department by way of construction of ponds, open wells etc. tsunami has greatly affected the waterbeds in the islands and hence scarcity of ground water. Another discerning factor is that the ground water is not potable due to the high content of saline.

The status field report, which has been collected from the APWD, confirms that both the schemes are not functioning due to seepage of water underneath on its completion and damage of major portion of the canal during the massive Earthquake, which followed by tsunami waves struck in December 2004.

The storage water available at the dam site of the RK PUR minor scheme for a good part of the year is being utilized to meet the water supply requirement of adjoining villages (not for irrigation) .In the year 2003 there has been one schedule release of water but the information which we collected from the sample farmers have confirmed that the scheduled for water release was brought out and communicated, but in reality this never happened. Water was released only once as per the schedule.

So for practical understanding both the dams which were constructed are not able to meet the irrigation requirements of the cultivable area due to technical disadvantages and as well of the damages during the Tsunami earth quakes .So this has primarily caused major gaps in the potential created and potential utilized as actual utilization is completely absent in both the cases.

After the tsunami more time and efforts have been spent in rehabilitation and relief work and there has been total neglect on this front.

After 2005 till date various reports have been submitted in order to rectify the situation and increase the storage capacity of the dams.

Another significant factor, which has created problems for water distribution from the dams, is the silt accumulation and weeds in the canals, which have not been removed for many years since the construction. It is very evident from various reports that the technical flaws like seepage, the structural flaws in the initial construction itself like the level of the free board has resulted in the project not taking off as desired .The public has also been largely responsible for spilling garbage in the canals.

The communication reports from the water ministry and the irrigation /agriculture department has indicated that a separate committee (April 2007) has been set us in order to examine all the related issues and identify an appropriate mechanism for large-scale investments in irrigation in all projects in the region. Till date there is no apparent change in the situation.

Around 45 families in the VNMI scheme living around the canal area of 15 meters have handed over 12 heaters of land to the department. They have not got alternate allotment in lieu of the land given to the department In the case of RK PUR the compensation of land acquisition has been completed.

New projects and new requirements are being generated through public meetings. Many projects have been identified and sent to the ministry, the reports confirm that the process takes a very long time due to delay in sanctions and approvals as several clarifications and queries need to be submitted at various intervals of time. Funds are released as cumulative and not for single projects so disbursement and usage of the funds are also very sensitive in most of the cases.

The agriculture department has been conducting various training programs for farmers conveying the different schemes, the type of crops to grow technical know how for cultivation and soil advice.

9.2.6 Main Requirements in Both Dam Sites

- To stop dam seepage at the bottom of the dams – to stop leakage and to increase the water level.
- Repair and maintenance canals
- Distributaries to be built
- To construct walls/gates for release of water
- Redesign of canal in areas elevated / tilted during the tsunami.
- For future development and project work to be carried out the land dispute between the farmers and the government has to be settled amicably.

9.3 Goa

9.3.1 Secondary Data Provided On Irrigation Projects

Anjunem Irrigation Project:

It is located on Costi nadi at Anjunem village in Sattari taluka of north Goa district, a tributary of Valvanti river under Madei Basin. The project report envisaged a irrigation potential of 2100 ha with intensity of irrigation of 220% (kharif – 100%, rabi-60% and summer 60%). 16 Water User Associations have been formed and they take up maintenance works of main canal water courses field channels within their jurisdiction upto a limit of Rs. 1.5 lakhs.

Salaulim Irrigation Project:

The total potential created is 4740 ha and out of which 2701 ha is presently irrigated under this project. 28 WUA formed under this project are taking care of the respective command area irrigation activities.

Table 9.9: Details of Tail End Reach of LBMC of SIP

Tail end reach of LBMC of SIP	Potential created (ha)	Potential utilized (ha)	Gap (ha)
1. Main Canal direct outlets	223.00	175.00	48.00
2. Branch canals (D1-13) & water course(1-18)	671.93	281.00	390.93
3. Minor M3	370.00	37.00	333.00
Total	1264.00	493.00	771.00

The main reasons for the gaps are given below

1. The Topography of the state of Goa is peculiar having a contribution of hilly and plain terrain.
2. The poor retention water capacity of the soil being lateritic in nature.
3. The fragmentation of land which leads to very small holding size.
4. The peculiar problems of owners and tenants of the state which leads to litigation among them resulting in non cultivation of the land.
5. Non availability of local labourers and increase in the cost of labour wages from other states.
6. Urbanization and high literacy rate of the state which has drifted the younger generation from taking their traditional agriculture.
7. Curtailment of command area from some distributaries by the government.

9.3.2 Estimation of Gap between Irrigation Potential Created and Utilized (Goa)

The ideal method for estimating the gap between the irrigation potential created and utilized would be to calculate the difference between the total area localized for irrigation at the time of commissioning the irrigation project and the actual area that is under irrigated crops in each year. The variation between area localized and actual area irrigated is expected because of various reasons. Some of these reasons are:

- Deviation from the originally envisaged at the time of formulating the irrigation project
- Difference in the water inflows into the reservoir (in case of storage of water involved) or low recharge of ground water (in case of ground water being the source of irrigation)
- Measurement of area irrigated (there is a variation in the measurement by different departments involved with irrigated agriculture)
- Seepage losses in the transmission of water
- Rainfall in the command area (as well as in the catchment area)
- Lack of night irrigation
- Unequal distribution of water between the head reach, mid reach and tail reach

Unfortunately no data was available at the project level for any of the projects selected for the study. Hence the estimation of the gap between the irrigation potential created and utilized had to be based on the primary data collected from the sample farmers.

Data with respect to the irrigated area owned, leased in and leased out was collected from the sample farmers. The location of each farmer in terms of the head reach, mid reach and tail reach is also identified. In addition, the area of the sample farmers under major, medium and minor irrigation schemes is also identified. The data on actual area that was under irrigated crops in the year 2006-07 was also collected. The details of the irrigated area owned, leased in and leased out for the sample farmers is presented in the table below. The total area available for irrigated crops with the sample farmers is 623.08 acres. Of this area, only one acre is in the head reach, 34.50 acres are in the mid reach and another 357.70 acres are in the tail reach. Similarly, 86.03 acres are under major irrigation projects, 307.17 acres are under medium irrigation projects and the remaining 229.88 acres are under minor irrigation projects. Details are given in Table 9.10.

Table 9.10 Details of Area under Irrigated Crops

Irrigated Area Owned					
	2006-07				
	H	**M**	**T**	**Minor**	Total
Major	0.00	2.00	71.78		73.78
Medium	1.00	32.50	266.67		300.17
Minor				223.38	223.38
	1.00	34.50	338.45	223.38	597.33
Irrigated Area Leased IN					
	2006-07				
	H	**M**	**T**	**Minor**	Total
Major	0.00	0.00	12.25		12.25
Medium	0.00	0.00	8.00		8.00
Minor				6.50	6.50
Total	0.00	0.00	20.25	6.50	26.75
Irrigated Area Leased Out					
	2006-07				
	H	**M**	**T**	**Minor**	Total
Major	0.00	0.00	0.00		0.00
Medium	0.00	0.00	1.00		1.00
Minor				0.00	0.00
Total	0.00	0.00	1.00	0.00	1.00
Irrigated Area Available for Irrigated Crops					
	2006-07				

	H	M	T	Minor	Total
Major	0.00	2.00	84.03	0.00	86.03
Medium	1.00	32.50	273.67	0.00	307.17
Minor	0.00	0.00	0.00	229.88	229.88
Total	1.00	34.50	357.70	229.88	623.08

In the year 2006-07, the gap is the highest under the major irrigation schemes in Kharif season. On the other hand, the gap is highest under the medium irrigation schemes in the Rabi season. While the overall gap is 51.37 percent in Kharif season, it is higher at 62.22 percent in the Rabi season. This gap in Rabi season is higher even though the gap under major irrigation schemes in Rabi season is negative. In other words, the sample farmers have reported a higher area under irrigation (higher than the potential) in Rabi season. One of the interesting aspects of Goa is that the area utilized for irrigated under the major projects in Rabi season is more than the irrigation potential created. This could be due to additional area irrigated by the sample farmers by using the irrigation water as well as monsoon rains judiciously.. Unfortunately, there was no information or data from the state department of irrigation and hence the gap is calculated to provide an indication of the irrigation potential created and utilized. On the face of it, the gap in the head reaches under major irrigation schemes appear to be zero in Rabi season, but the fact is that there is only one farmer from the head reaches in the sample.

Area under Irrigated Crops (acres) and Gap between Irrigation Potential created and Utilized (based on data from Sample farmers) is presented in table 9.11

Table 9.11 Area under Irrigated Crops (Acres) and Gap (Percentage)

Kharif						
	2006-07					
	H	**M**	**T**	**Minor**	Total	**GAP (%)**
Major	0.00	0.00	1.04		1.04	98.79
Medium	0.00	18.25	153.88		172.13	43.96
Minor				129.85	129.85	43.51
	0.00	18.25	154.92	129.85	303.02	51.37
Gap (Percentage)	100.00	47.10	56.69	43.51	51.37	
Rabi						
	2006-07					
	H	**M**	**T**	**Minor**	Total	
Major	0.00	2.00	98.77		100.77	-17.13

Medium	1.00	5.00	57.56		63.56	79.31
Minor				71.06	71.06	69.09
	1.00	7.00	156.33	71.06	235.39	62.22
Gap (Percentage)	0.00	79.71	56.30	69.09	62.22	
Summer						
	2006-07					
	H	**M**	**T**	**Minor**	Total	
Major	0.00	0.00	9.50		9.50	88.96
Medium	0.00	6.55	78.43		84.98	72.33
Minor				48.00	48.00	79.12
	0.00	6.55	87.93	48.00	142.48	77.13
Gap (Percentage)	100.00	81.01	75.42	79.12	77.13	

It should be noted that the gap estimated in the table above is based on the data obtained from the sample farmers. Since it is based on the sample, there is an uncertainty associated with these estimates. In order to get a better estimate of the gap between the irrigation potential created and utilized, a 95 percent confidence interval has been estimated. These confidence intervals have been presented in the table below. These confidence intervals provide a better estimate of the gap between the irrigation potential created and utilized since they have a confidence level associated with them. The confidence intervals for the scenario where the utilization is more than or equal to the potential created, was not calculated. Similarly where the gap is 100 percent, the confidence interval is not calculated and the same is presented in table 9.12

Table 9.12 Limits of Gap Based On Survey Data Analysis

Category	No of sample farmers	Kharif			Rabi			Summer		
		Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit	Gap	Lower Limit	Upper Limit
Major	**76**	**98.79**	**96.33**	**101.25**	**-17.13**	**Not calculated**		**88.96**	**88.96**	**88.96**
Medium	118	43.96			79.31	72.00	72.00	72.33	72.33	72.33
Minor	72	43.51	32.06	54.97	69.09	58.41	79.76	79.12	79.12	79.12
Head	1	100.00	Not calculated		0.00	Not calculated		100.00	Not calculated	
Mid	14	47.10	20.95	73.25	79.71	59.36	100.00	81.01	81.01	81.01
Tail	179	56.69	49.43	63.95	56.30	49.03	63.56	75.42	75.42	75.42
Total	266	51.37	45.36	57.37	62.22	56.40	68.05	77.13	77.13	77.13

CHAPTER 10

ANALYSIS OF PRA WORKSHOPS AND OFFICERS' QUESTIONNAIRE

CHAPTER 10

ANALYSIS OF PRA WORKSHOPS AND OFFICERS' QUESTIONNAIRES

10 General

This chapter deals with the findings of PRA workshops conducted by Indian Institute of Management Bangalore in Karnataka, Andhra Pradesh and Kerala. In addition, this chapter also deals with the results of the survey conducted by Indian Institute of Management Bangalore from the officers associated in irrigation operations in the field in different state.

10.1 Findings of the PRA Workshops

Indian Institute of Management Bangalore has organized three PRA workshops, one each in Andhra Pradesh, Karnataka and Kerala. These workshops are attended by officials of various departments concerned with irrigated agriculture as well as non-officials. The officials are drawn from Irrigation Department, Revenue Department, Agriculture Department and Directorate of Economics and Statistics. These PRAs are also attended by the representatives of various Water User Societies such as chairmen, presidents, secretaries and members. In addition, ground level workers such as "Patkaris" also attended the workshops.

These workshops are conducted with the primary objectives of understanding various methods of measuring irrigation potential created, utilized and the gap, if any. These workshops are also used to elicit the opinions of the officials of various departments as well as non-official representatives with respect to various aspects of irrigation.

The important points that emerged from the workshops are as follows:

- The water released into the main canals as well as the water inflows and outflows in the reservoir are measured regularly with respect to major and medium irrigation projects. On the other hand, no measurement of water is carried out at the field level.
- The irrigation department also notifies the area to be supplied with water based on the initial inflows. The farmers are free to grow whatever crops that they desire based on the notification. The other departments such as agriculture department are unable to influence the farmers on appropriate cropping pattern, leading to a significant gap between the potential created and utilized. There is no coordination between various departments and farmers.
- Water charges are collected under minor irrigation schemes based on the extent of area under different crops. There was no volumetric measurement of water under minor irrigation schemes.
- Power supply is a major reason effecting irrigated area under minor irrigation schemes.
- One of the major reasons for not utilizing the full potential created is the lack of maintenance of canals, distributories and fields channels. While the responsibility of maintaining the field channels lies with the farmers, the maintenance of canals and distributories is the responsibility of the department and the water user societies. The maintenance work is not carried out regularly because of paucity of funds. The problem is acute even in areas where the responsibility of collection of water charges and maintenance of canals and distributories has been handed over to the water user societies. The societies are unable to collect the water charges due to political interferences.
- Many participants expressed that the maintenance expenditure is very low and the reduction in irrigated area due to improper and inefficient maintenance could be as high as 18 to 20%. The maintenance expenditure depends upon the topography, number and type of irrigation structures, intensity of rain fall and soil type. The participants of Karnataka and Andhra felt that a maintenance grants of

the order of Rs.400 to 500 per ha is required whereas in Kerala the maintenance expenditure could be as high as Rs.10,000 to 12,000 per ha.

- There is excess usage of water in the head reaches leading to wastage and resulting in shortage of water in the tail reaches.
- The cropping pattern followed in the command area is significantly different from the cropping pattern originally envisaged in major and medium irrigation schemes at the time of project preparation. Consequently, the area actually irrigated is much less than envisaged because many farmers have resorted to high water consuming crops.
- There is no proper training for the field level officials on efficient methods of water usage.
- Some of the fields have become saline due to water logging and consequently, the potential created is not utilized.

10.1.2 Processes in Measurement of Water and Irrigation Potential

It is important to identify the processes involved in measurement of water and the calculation of irrigated area in order to understand the gap between irrigation potential created and utilized. The PRAs are also used to elicit opinion of the participants with respect to various issues involved with measurement of irrigation water. The findings on these issues are presented below.

- While the quantity of water that is released into the main canals is measured with a fair degree of accuracy, there is no measurement done at the field level. In some cases, even the quantity of water released into the distributories is not measured nor accounted for.
- Water discharges at different points in the main canals are monitored.
- Water measurement is done to some extent where the responsibility of water distribution is handed over to the water users' societies.
- Water charges actually collected is used as a measure of irrigation potential utilized. When the area is actually irrigated, but water charges are not paid due to

conflicts with the farmers, such irrigated area is not accounted for in the calculation of potential utilized.

- It was felt that there is need to measure water at the field level and that the estimation of potential utilized should be de-linked from the collection water charges. Various departments involved in irrigated agriculture should carry out joint inspection during the cropping season and resolve inter-departmental conflicts and provide a common estimate of the area actually irrigated. This is being practiced in AP since two years.
- It was suggested that the irrigation potential created and utilized need to be measured in terms of water released. The quantity of water that was proposed to be released as per the original project report need to be considered as the potential and the utilized will be the quantity of water actually released in each year. This measure will be neutral to deviations and changes in the cropping patterns
- Many officers informed that there is a large scale unauthorized tapping and water is drawn for irrigation. However, they are not accounted since they fall outside the defined command area. It is necessary to consider all the area irrigated, whether it is authorized or not
- In addition, the following suggestions have emerged from the PRAs
    - The Water Users' Associations should be made responsible for measuring the quantities of water released into the distributories as well as at the pipe command level
    - Additional and judicial powers need to be given to the irrigation department for controlling unauthorized use of irrigation water.
    - An Irrigation Consultation Committee needs to be set up so as to match the cropping pattern with the available water
    - Rotation of irrigation in the command area is to be strictly practiced
    - There is a need to release sufficient funds for maintenance works in order to minimize the transmission losses and seepage

Water supply in the head reaches needs to be controlled based on suggested cropping pattern.

10.1.3 Reporting practices followed by different states

As mentioned earlier, different states follow different practices for reporting various parameters leading to the quantification of gap between IPC and IPU. Also, there are a number of departments involved in different states in the process of identification and measurement. Table 10.1 summarises various practices followed by different states.

Table 10.1 Reporting practices followed by different states

State	Water Measurement		Area Measurement	
	Major and Medium	Minor	Major and Medium	Minor
Karnataka	Measured by the irrigation dept.	Not done	By irrigation dept. and Agrl dept separately. Revenue dept is given the figures by irrigation dept for collection of water rates. Discrepancies are resolved through joint inspection by revenue and irrigation dept. Bureau of economics and statistics collects data by the taluks and districts, but not by project. Wherever farmers associations are active, measurement as well as	Not done

			collection of water rates is done by the farmers' organizations and reported to the department	
Andhra Pradesh	Done by Irrigation Dept	Not done	Done jointly by Agrl., Irrigation and Revenue depts. Reconciliation is done at the Mandal level. Bureau of economics and statistics takes these reconciled figures.	Only the farmers declare.
Tamilnadu	Done by Irrigation Dept	Not done	Irrigation department does the measurment	Only the farmers declare.
Kerala	Done by Irrigation Dept	Not done	All the departments (Irrigation, Agriculture, CADA, Revenue) do it independently.	Only the farmers declare.
Maharashtra	Done by Irrigation Dept	Not done	Irrigation Department carries out the measurement.	Only the farmers declare.

As shown in the table above, there are variations in the reporting practices. It is necessary to standardize these practices across different states. The schedules for this purpose are given in section 10.5. These schedules are designed to facilitate identification of the gap not only at the project level but also at the disaggregated level such as distributaries.

10.2 Opinion Survey of the Officials of the Irrigation Department

An opinion survey of the officials of the Irrigation Department in the study area was carried out with the help of a structured questionnaire. The aim of the survey is to elicit their opinion with respect to various aspects of irrigation such as delivery of required quantities of water, collection of water charges, issues in measurement, roles and responsibilities of Water Users' Associations, interaction with other government departments etc. The major findings of the survey are presented in this section.

10.2.1 Delivery of Irrigation Water

- A periodic assessment of water requirement is carried out based on the monsoon status in the region. Based on the water inflow into the reservoirs, a notification with respect to the possible release of water is announced. The area proposed to be irrigated is estimated based on certain assumptions on the cropping pattern to be followed. It is expected that the farmers will take note of the notification in planning their cropping pattern
- Water releases are documented on a daily basis in the case of major irrigation projects where as seasonal records are maintained in medium projects.
- There is no standard procedure for measuring the water delivered. Various methods are used for this purpose. Some of the methods used are
    - Gauge plate and gauge register
    - Discharge is calibrated based on depth of water
    - Eye judgment
    - Measuring devices installed at the off-take point of the canal
- Area under irrigation is assessed by surveying the fields. The survey is carried out by the irrigation department (Patkari). There is no coordination with the Agriculture Department or Revenue Department or The Directorate of Economics and Statistics. The estimates of different departments vary due to lack of coordination. It is suggested that a joint inspection by the officers of all the concerned departments should be carried out and the conflicts, if any, should be resolved at the Block level. This practice is currently in practice in AP since two years.

- The methodology for estimating the gap between irrigation potential created and irrigation potential utilized should be redefined. The area proposed under irrigation at the time of project preparation should not be considered as the potential created. The potential should defined as the area notified each year based on the water availability in the reservoir. The gap should be calculated based on this definition. The impact of varying levels of inflows is neutralized in this method of calculations.
- Farmers resort to alternate sources of water for supplementing the surface water. Sometimes, these alternate sources are outside the notified command area. It is suggested that even these areas should be taken into account for estimating the potential utilized because these alternate sources get water from recharge and regeneration.
- In case of tank irrigation, water is released by a person employed by the farmers and release pattern is based on the requirement of the farmers. There are no measuring devices in practice and the documentation is done only on the basis of recording the water level in the tanks before and after the cropping season.
- There is no method at present for accounting for the unauthorized irrigation. It is perceived that this unaccounted area sometimes account for 10 to 15% of the actual area irrigated. This needs to be quantified through satellite maps of the project area.

10.2.2 Interaction with other Departments

There are a number of government departments involved in irrigated agriculture. These departments are:

- Revenue Department involved in collection of water charges and tax
- Fisheries Department involved with inland fisheries
- Police Department is involved in patrolling and help in water regulation and preventing unauthorized use of water
- Soil Conservation for assessing and maintaining the quality of soil

- Agriculture Department for advising the farmers on proper cropping pattern and package of practices
- Command Area Development Authority for integrating various requirements.
- Non-governmental agencies such as Water Users' Associations and other NGOs.

The sharing of information and coordination among these departments is not at the required level. Often, there is no coordination. It is suggested that there is an urgent need for joint inspection by the concerned departments, especially Irrigation Department, Revenue Department and Agriculture Department.

10.2.3 Collection of Water Charges

Very often, the irrigation potential utilized is estimated based on the water charges collected. A crop demand statement is prepared by the Irrigation Department based on the area irrigated in Kharif, Rabi and Summer season and sent to the Revenue Department for collection. In certain areas, the water charges are collected by the corporations such as Karnataka Neeravari Nigam Limited or the Water Users' Associations or cooperative societies.

There are large amounts of arrears and this consequently affects the maintenance works, especially where the activity of maintenance has been handed over to the Water Users' Associations. These arrears also result in under estimation of irrigation potential utilized. There are also instances of political interferences by promising waiver of water and land taxes.

10.2.4 Transfer of Irrigation Management to Non-Governmental Bodies

The management of irrigation has been handed over to non-governmental bodies such as Water Users' Associations in many major projects in a number of states. Some of the benefits perceived from this transfer are as follows:

- The difficulty of night patrolling by the department officials has been removed
- There is a reduced responsibility and considerable cost saving to the department

- Increased involvement of farmers in the irrigation water management in the command area
- Supervision of the entire canal system by the Associations has increased and is more effective.
- Improvement in the collection of water charges
- More equitable distribution water among farmers
- More effective control of unauthorized irrigation
- Better maintenance of the canal system

The experience of these non-governmental bodies has been mixed. There is a very wide variation in the effectiveness of these bodies within the same state and across different projects. It is hoped that all these bodies will become more effective in the future.

10.3 Reasons for the Gap Between Irrigation Potential Created and Utilized

- Measurement Problems:
    - The estimates made by the Irrigation Department do not take into account the unauthorized irrigation and pilferages of water.
    - The Revenue Department goes by the revenue collected and not by actual area irrigated
- Design Problems
    - There are certain assumptions made at the time of designing the project. It is necessary to verify the validity of these assumptions after completing the project and redefine the quantum of potential created
    - The average rainfall in the area over a period of 30 years or so is considered while designing the project and calculating the dependable yield. It does not make any allowances for variations.
    - The assumption made about the cropping pattern at the time of estimating the irrigation potential created may hold good after implementation of the project.

- Availability of water at the beginning of each agricultural season should be the criterion for defining the potential created. In other words, the potential is based on the availability of water in a particular season and varies every year.
- The estimation of potential utilized should also take into account the canal breaches and unauthorized irrigation.

10.3.1 Suggestions for Bridging the Gap

It was suggested that water management in the command area should be taken up by the Federation of the Water Users' Associations and Cooperative Societies. Data should be collected on cropping pattern adopted and season-wise water requirements of crops. Proper upstream controls should be put in place to make sure that sufficient quantity of water reaches the tail end farmers. Proper measurement of water should be carried out at all location from the main canal to the farm level.

10.4 Definitions of Terms Normally Used In Irrigation

In the course of the PRAs and discussions with the officials from various departments involved in irrigated agriculture, the definitions for some of the commonly used terms in irrigation are evolved. These definitions are given in this section.

- Potential Created: It is a geographical extent in the command area, which is supplied with water for crops through the complete networks of distribution system as per the quantity of water and crop pattern as conceived in the project report.

- Potential utilized: Every year and every season in the year, it may not become possible to get the total quantum of water as envisaged in the project report. Depending upon the climatological conditions the total rainfall and in turn the total quantity of water available for irrigation may vary. In such a case, only the part of geographical area in the command area may get water for irrigation of

crops. This is referred to as potential utilized. This can also be on account of incomplete or inefficient distribution system. It may be defined as the irrigation potential used in the command area for cultivation, corresponding to the supply of irrigation water, as per the availability.

- Gross Command Area: (GCA): It is the area enclosed inside the imaginary boundary line, up to which certain irrigation channel (or net work of distribution system) is capable of supplying water for irrigation purposes to the furthest point. The gross command area includes uncultivable area such as small drainage ponds, forest, saline soils, houses, roads, other barriers etc.

- Gross cropped Area: In various seasons like rabi, summer, kharif, percunial, the same irrigated land is used more than once i.e. on the same cultivable area, the crops are grown 2 or 3 times in a year. This total cultivable area utilized for cultivation in a year is called Gross Cropped Area. It is also defined as the total gross area proposed to be irrigated under different crops, during a year by the scheme/ or project. The area purposed to be irrigated under more than one crop, during the same year is counted as many times as the number of crops grown.

- Net Cropped Area: It is the geographical culturable cultivated area in the command during any one season such as kharif or any other season.

- Gross Irrigated Area: The total irrigated area under various crops during a year, counting the area irrigated under more than one crop, during the same year as many times as the number of crops grown.

10.5 Quantification of Gap between Irrigation Potential Created and Utilized

The data maintained by the irrigation department at present is highly inadequate to quantify the gap and the major reasons responsible for the same. It is felt that data may be maintained in the formats given below for the project as a whole, at the main canal and at each distributory-wise. A comprehensive analysis of this data at least once in three

years may help the project authorities to identify the major contributing factors for the gap and remedy the same.

Schedule No.1					
Salient Features					
The Salient Features of the Major/Medium project: [Name]					
Sr.No.	**Item**	**Description**		**Unit**	
1	**Location**				
2	**River**				
3	**River Basin**				
4	**Classification**				
5	**Water spread area**				**Sq.Km.**
6	**Year of Starting**				
7	**Year of Completion**				
8	**Length of Dam**				**meters**
9	**Max.height of Dam**				**meters**
10	**Gross storage (new)**				**Mcum.**
11	**Live storage (new)**				**Mcum.**
12	**Catchment Area**				**Sq.Km.**
13	**Av.Rainfall in the catchment area**				**cm.**
14	**Length of canal in km.**		**i) LBC**		**km.**
			ii) RBC		**km.**
15	**Branches in km.**		**i) LBC**		**km.**
			ii) RBC		**km.**
16	**G.C.A. (in Ha.)**		**i) LBC**		**Ha.**
			ii) RBC		**Ha.**
17	**I.C.A. (in Ha.)**		**i) LBC**		**Ha.**
			ii) RBC		**Ha.**
			Total		**Ha.**

	Schedule No.2 - Part 1							
S. No.	Details of Discharge and ICA For Each Distributory and Main Canal							
		Location	Dy.1	Dy.2	Dy.3	Dy.4	Dy.N	Total
		Left/Right						
1	Offtake chainage (km/...m)							
2	Name of Distributory							
3	Total length of Distributory in km.							
4	Discharge at Head in Cumecs							
5								
6	Previous Year							
7	Current Year							
8	Reasons for the difference Rows 6 & 7							
9	Total Cummulative ICA upto this Distributory in Heacters							
10								
11	Previous Year							
12	Current Year							
13	Reasons for the difference Rows 11 & 12							
14	Expenditure on maitenance of the canal network							
15								
16	Previous Year							
17	Current Year							
18	Reasons for the difference Rows 16 & 17							
19	Actual crops grown (ha)							
20	a) Crop 1	Previous						
21		Current						
22	b) Crop 2	Previous						
23		Current						
24	c) Crop 3	Previous						
25		Current						
26	d) Crop 4	Previous						
27		Current						
	Note: Consolidate this information for each main canal							

Schedule No.2 - Part 2					
Sr.No.	Item	Description		Unit	
1	Potential Created (in Ha.)				
	i) LBC and Branches				Ha.
	ii) RBC and Branches				Ha.
			Total		Ha.
2	Details of cropping Pattern				
	Kharif				Ha.
	Rabi Two Seasonal				Ha.
	Hot Weather				Ha.
	Perrineal				Ha.
			Total		Ha.
3	Planned water utilization (Mcum.)				
	1) Irrigation				Mcum.
	2) Non Irrigation				Mcum.
	3) Evaporation				Mcum.
			Total		Total
4	Details of Irrigation water utilization (Mcum.)				
	Kharif				Total
	Rabi				Total
	Hot Weather				Total
			Total		Total

Two schedules are presented in the report. These formats have been designed so that all the data required for calculating the IPC and IPU are collected with very little effort.

10.5.1 Procedure for collecting the data:

Schedule 1 captures salient features of the project. These need to be taken from the project report at the time of completion of the project. This data is static in nature and

does not change from year to year. This data is to be used for comparing the actual utilization and for identifying the reasons for gap as explained in section I above.

Schedule 2 – Part 1 is the data with respect to the inflow of water as well as utilization of water. Additionally, it involves collection of data with respect to the cropping pattern actually followed in the command area. This data needs to be collected on an annual basis. Data with respect to items (Sl. Nos.) 1 to 18 need to be collected by the irrigation department staff on a weekly basis. This data needs to be collected for each distributory. While filling the data for the current year on a weekly, basis, the figures for the corresponding week in the previous year should be entered beforehand. This will facilitate the calculation of the differences between two consecutive years. While the field staff of the irrigation department collets this data, it is aggregated at the canal level and the project level through the offices of the Asst. engineers and Executive Engineers.

The details for Sl. Nos. 19 onwards need to be collected through a joint inspection by the three departments namely, Irrigation department, Agricultural Department and Revenue Department. It is suggested that a separate inspection committee be formed for this purpose. It is also recommended that the Executive Engineer from the Irrigation department/ CADA be made the head of this committee. The other members of the committee will be the revenue officer from the concerned Mandal/ Taluk/ Block and the agricultural officer of the concerned Mandal / Taluk/ Block. This committee will carry out joint inspection of the area irrigated once at the beginning of the cropping season (Khairf or Rabi or Summer) and again at the end of the cropping season. This committee will resolve any differences by inspection and fill in the data in the above Performa. It is suggested that the first inspection of the cropping season should be carried out immediately after the sowing season in the command area of each distributory. Similarly, the second inspection of the cropping season is to be carried out just before the harvesting of the crop. It is possible that different farmers will have resorted to different crops under a particular distributory and the time of sowing as well as harvesting may be different for different crops (for example, sugarcane and paddy). The committees should

take these aspects into account before planning the inspections. If necessary more inspection need to be carried out. The discrepancies arising between the first inspection and the second inspection need to be resolved within the committee.

It also should be noted that the data collection for Schedule – 2 (part 1) is on a weekly basis for items 1 to 18. These data items need to be aggregated for the entire cropping season a year before finally filling the Schedule.

Once Schedule 2 (part 1) is filled, various items in Schedule 2 – part 2 need to be calculated as explained in Section I above.

This approach will help in estimating the gap attributable to various reasons, outlined in Section I above.

10.5.2 Methodology for Quantifying the Gap

- Potential Created: It is the geographical extent in the command area, which is supplied with water for crops through the complete networks of distribution system as per the quantity of water and crop pattern conceived in the project report.

The above definition is generic in nature and the Irrigation Potential Created (IPC) is normally considered as static. In reality, this refers to the extent of area that can be irrigated based on the irrigation water that is made available from year to year. This quantity of water made available is a function of inflow into the reservoirs in the case of major, medium projects and tanks, and ground water recharge in the case of minor irrigation through wells. Hence, it is necessary to consider the variation in the inflow/ recharge of water in calculating IPC. In other words, IPC cannot be treated as static, but has to be recalculated annually based on the water that is made available through the irrigation structures.

In addition, the actual area brought under cultivation depends on the cropping pattern followed in the command area. At the time of project initiation, the proposal envisages a certain cropping pattern and based on the consumptive use of water for these crops, the extent of area that can be irrigated is estimated and declared as potential created. Since there cannot be any crop regimentation in India, the farmers are free to grow the crops that they desire. Normally these decisions are based on the income and risk considerations as well as the resource endowment with the farmers. Thus, the cropping pattern actually followed in the command area along with the water available for irrigation should be considered in estimating the IPC on an annual basis.

The methodology to be followed for estimating the potential created (IPC) as suggested below:

1. The actual inflow of water into the reservoir/ tank is to be recorded first.
2. The actual cropping pattern followed by the farmers is to be obtained.
3. Data on water requirements for different crops in the cropping pattern is to be collected based on the agricultural experiments carried out in the command area
4. Based on the above consumptive use of water for different crops and the water inflow recorded in step 1, IPC for the particular year is calculated.

The Gap between IPC and IPU is to be estimated as follows:

1. The actual area under crops in the command area (as envisaged in the project proposal) is the IPU
2. The difference between estimated water inflow into the reservoir as per the original project proposal and actual inflow for the particular year is to be calculated. The area that could have been irrigated based on the actual cropping pattern followed in the command area in that particular year is to be calculated (using the consumptive use of water for the crops). **This is the Gap attributable to shortfall in water inflow**.

3. The area to be irrigated for the actual inflow of water in the particular year based on the cropping pattern as originally envisaged in the project proposal is to be calculated. The difference between this area so calculated and the actual area irrigated based on the actual cropping pattern is the **Gap attributable to deviations in the cropping pattern.**
4. The quantity of water released into each distributory is to be measured at the off-take point of the distributory every year. The proportion of water that is originally envisaged to be released into each distributory as per the project proposal is to be calculated. This proportion is to be compared with the actual proportion for the specific year. If the actual proportion is less that was originally envisaged, then the gap is to be calculated using the cropping pattern as explained in para 2 above. **This gap is attributable to administrative lacuna in providing equitable distribution of water**.
5. The water released into each canal and distributory is to be measured at the off-take point. The short fall of water, if any, at the off-take point as well as at the end of the canal/distributory is to be measured. This shortfall, after accounting for the gap as explained in pars 2 to 4, is to be converted into acreage as explained in para 2. **This gap is attributable to poor maintenance of the distribution system**.

10.6 Theoretical Reasons for the Gap

Measurement Problems

1. The figures computed by irrigation department do not take into account pilferages occurring due to pumping siphoning off of canal water, seepage/leakages through the canal beds and sides throughout the length of the canals
2. Revenue department goes by revenue collected and by past records

Design Problems

1. While arriving at the IPC, what are the criteria adopted by the irrigation department, subsequently whether these criteria's are met while assessing IPU,

needs to be verified by Irrigation Department to know the correct reason for the gap.

2. Generally the starting point for assessment of water availability in any project is past rainfall records going back to 30 years or more. Based on the average rainfall during the period under consideration dependable yield is arrived at. But 'average' rainfall does not say anything about timing and distribution of rainfall. Typically, if the timing and distribution is not of the right type, despite a high average rainfall, inflow into reservoirs will be less, resulting in lower IPC. The gap in this case is, of course, beyond control.
3. Also, it is important to find out if, at the time of project preparation, requirements of water for drinking and industrial use were taken into consideration. If not, water diverted for such uses will result in a gap. But this is not a real gap. This is something which can be set right.
4. If the gap is due to lower availability of water compared to DPR (e.g. 2above), it is not a gap. A gap will be defined as a situation when the availability of water is as per DPR, but there is a deviation between IPC and IPU.
5. In some cases, if actual water availability is more than DPR, it will be interesting to find out if any capacity storage tanks are created to store excess water.

Reasons for the Gap

Case 1: Actual water < DPR (In this case, the difference between IPC & IPU can arise from inability to supply water to the command area as per project report DPR).

a. Withdrawal of water for other purposes e.g. drinking water, industrial use
b. Timing and distribution of rainfall
c. Watershed drainage/leakages

Case 2: Actual = DPR but IPU<IPC

a. Due to non-availability of required infrastructure - non-maintenance of WCS/Distributaries e.g. growth of weeds, collapse of side slopes, damage to side and bed linings, reduced waterways, seepage and leakage of canal waters etc.

b. Gap due to regulatory problems and non-availability of measuring device.

c. Due to frequent breaches & unauthorized pumping

d. Violation of cropping pattern. The entire command area for the purposes of crops grown, will have to be looked into in three areas – namely, a) Initial reach (i.e. just downstream of water storage/ head) b) Middle reach and, c) Tail ends. The quantity of water reaching these zones vary on account of losses and friction encountered in the conveyance system. Generally farmers of initial reach and middle reach go for crops based on market signals and end up consuming more water. They do not follow the cropping pattern recommended by Irrigation Department. If crop pattern is not as per DPR, there will be considerable variation in consumption of water, thereby causing a gap. Rotation of crops in various seasons like Rabi, summer and perennial, must be as per DPR.

e. In case of minor irrigation, water management through farmers' federation of cooperative societies at various levels, is important. Data should be collected on crop pattern adopted, season wise/ crop wise water requirements, supply of water from the department as against measurement of water done while regulating to the fields in command area. Upstream controls provided, in order to see that water reaches the tail enders thereby gap between IPU and IPC for the major and minor irrigation can be reduced by adopting proper water management and crop pattern for the optimum utilization of waters available.

10.7 Explanation for Theoretical Gap

A BRIEF ON IRRIGATION POTENTIAL CREATED & UTILIZED

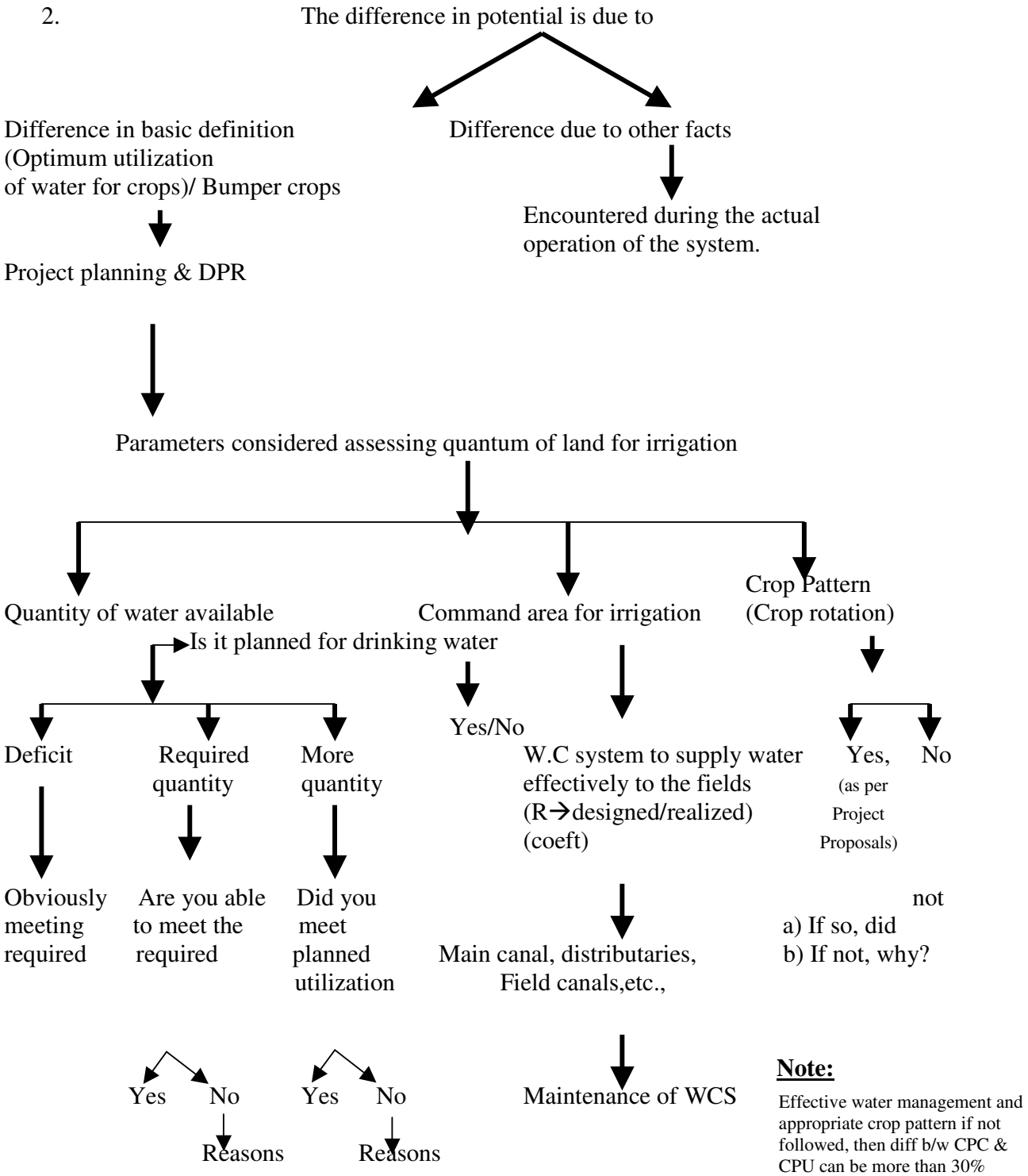
As per planning commission:

1. By 2003-2004, total Irrigation potential created is → 102.8 mha
   [through Major, Medium & Minor irrigation projects)

   But Total potential utilized is → 87.2 mha

   The diff is → 15.6 mha

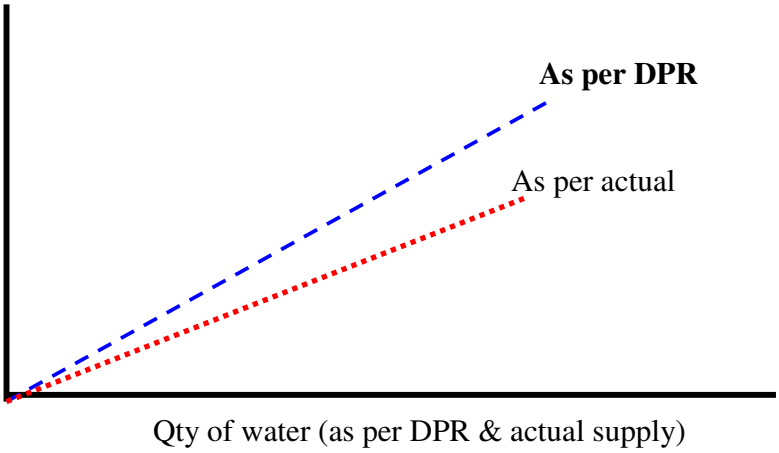
i.e., about 16% of the potential or about 18% of potential utilized in the GAP

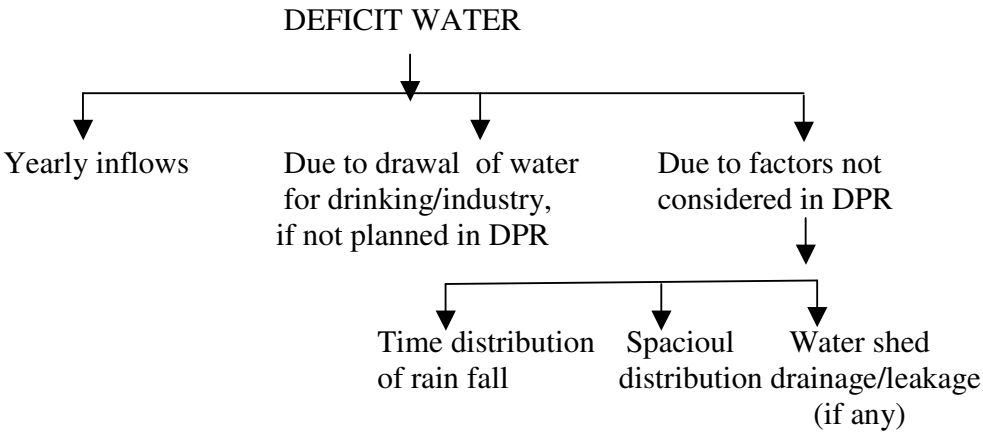

2.
The difference in potential is due to
Difference in basic definition (Optimum utilization of water for crops)/ Bumper crops
Project planning & DPR
Difference due to other facts
Encountered during the actual operation of the system.
Parameters considered assessing quantum of land for irrigation
Quantity of water available
Command area for irrigation
Crop Pattern (Crop rotation)
Is it planned for drinking water
Yes/No
Deficit
Required quantity
More quantity
W.C system to supply water effectively to the fields (R→designed/realized) (coeft)
Yes, (as per Project Proposals)
No
Obviously meeting required
Are you able to meet the required
Did you meet planned utilization
Main canal, distributaries, Field canals,etc.,
a) If so, did not
b) If not, why?
Yes
No
Yes
No
Reasons
Reasons
Maintenance of WCS
Note:
Effective water management and appropriate crop pattern if not followed, then diff b/w CPC & CPU can be more than 30%

Therefore the purpose is to assess this GAP between the planned potential and the utilized potential → GAP

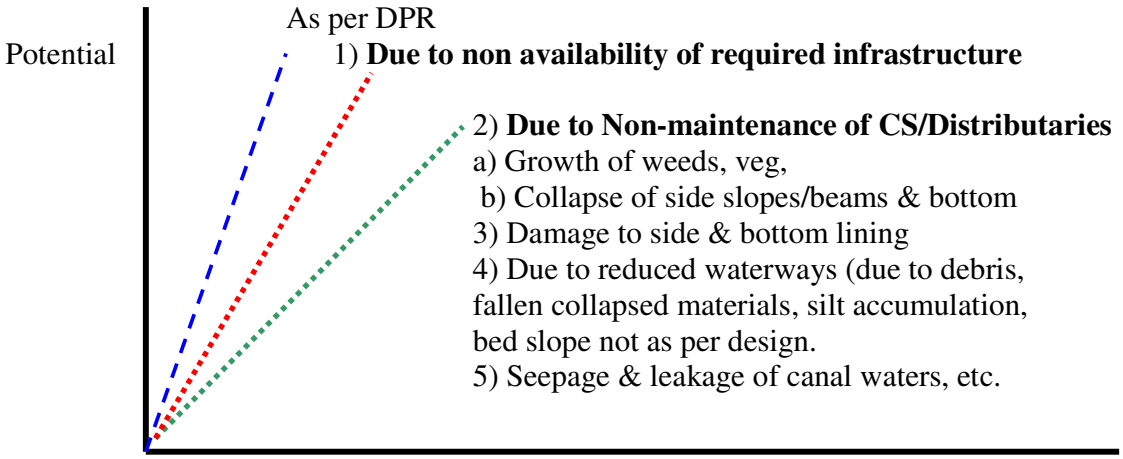
Causes for GAP:

1) **Command Area for Irrigation (Potential)**

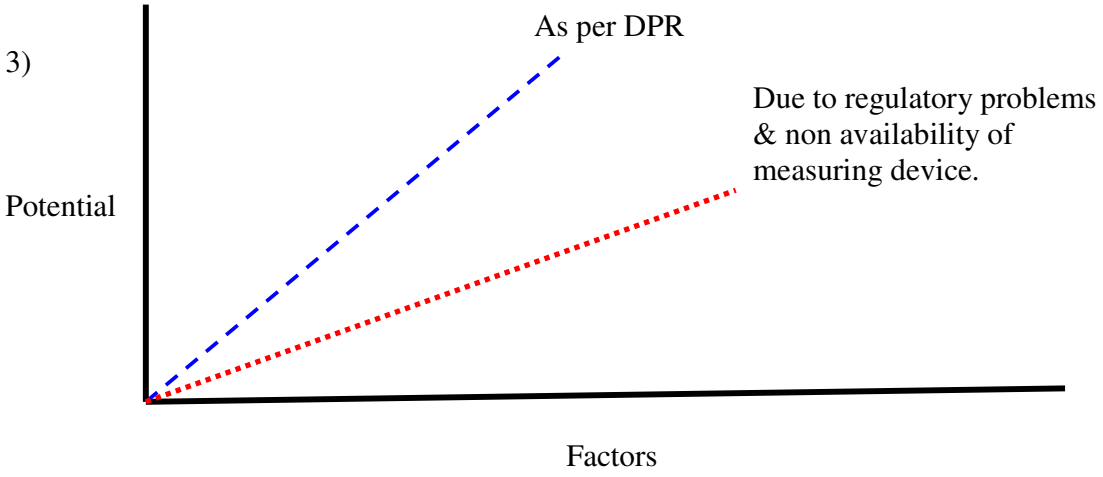




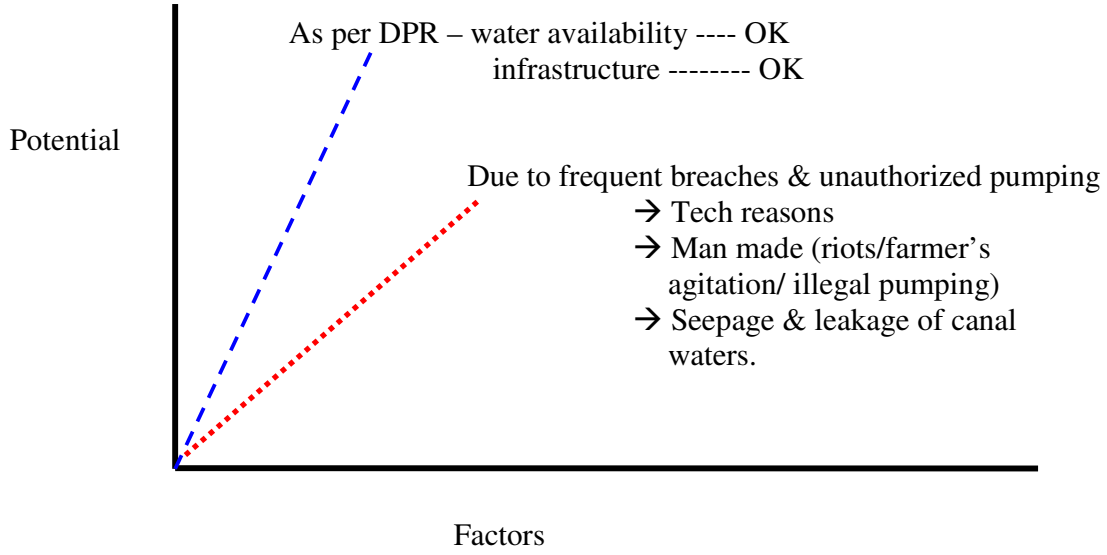
2)


Potential
As per DPR
1) Due to non availability of required infrastructure
2) Due to Non-maintenance of CS/Distributaries
a) Growth of weeds, veg,
b) Collapse of side slopes/beams & bottom
3) Damage to side & bottom lining
4) Due to reduced waterways (due to debris, fallen collapsed materials, silt accumulation, bed slope not as per design.
5) Seepage & leakage of canal waters, etc.
Factors

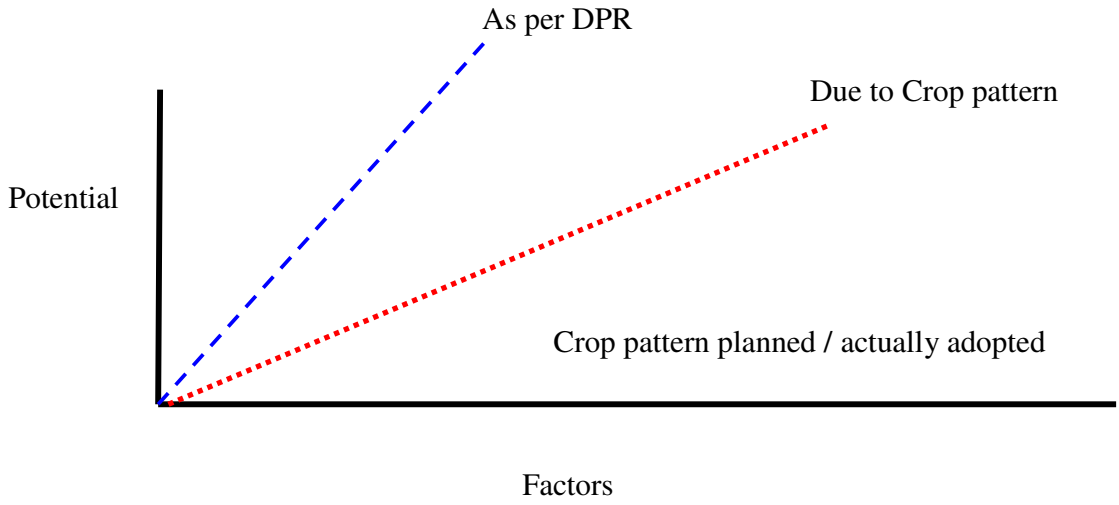
3)


Potential
As per DPR
Due to regulatory problems & non availability of measuring device.
Factors

4)



5) <u>If 1,2,3,4 are all OK, even then the GAP can be due to crop pattern</u>



The scope & objective of study

1) a) Examine various issues associated with potential created (CPC) and potential utilized (CPU)and Data maintained as per above points / parameters

b) Reporting practices / consistencies in date

2) To suggest procedure: (for standardization of data correction) → If it is not uniform in the state

To clearly identify the Irrigation potential which has been created but;

3) i) → has never been utilized (If so, reasons therefore)
ii) → has not been utilized regularly (if so, how this was achieved)
iii) → has gone to disuse due to various reasons → REASONS?

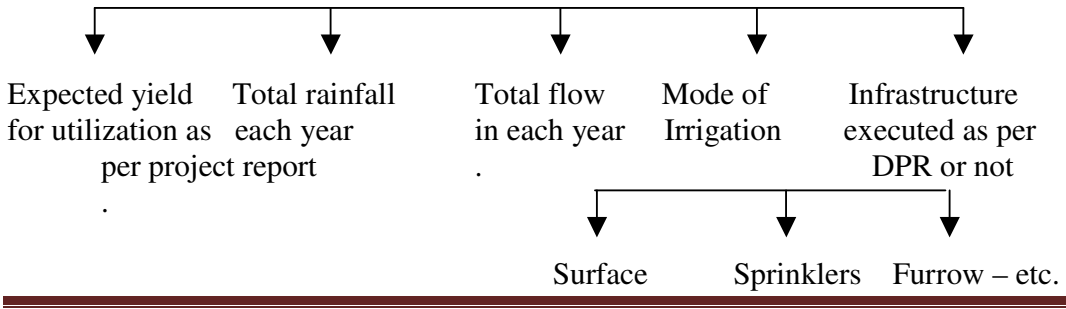
4) YOUR OPINION: a) About GAP between CPC & CPU or (IPC & IPU)
b) to suggest measures to minimize this GAP

DATA TO BE FURNISHED SHOULD INCLUDE:

1.
a) Potential as envisaged (project report) --------V/s Yield envisaged
b) Potential as per completion report
c) Actual area of irrigation done in different years -------V/s Corresponding actual yield
Canal /distributory/field channels - wise
d) CHANGES in CROPPING PATTERNS:
(cropping pattern suggested / adopted)

2. Data with respect to maintenance of the Project Infrastructure.

3. Yield of water (Reservoir Capacity)



Flow

The data to be furnished as per above details & opinions/suggestions required ----- include major, medium & minor irrigation (CPC & CPU)

1. Yield of water irrigation in various years → Reduction in yield

2. Water supplied for Kharif & rabi crops

3. Water supplied by each main/sub/field distributaries.(for Kharif & rabi)

4. No. of times water supplied by each distributory for Kharif & rabi crops

   Eg: (2 crops – 2 times) This helps to know Gross Irrigation potential utilized.
   (1 crop - 1 time)

5. Water drawn from reservoir for other purpose like Drinking, Industry etc., (Not envisaged in the Project Report)
   As a result net water available is less than planned → & hence its effect on IPC / IPU.

CHAPTER 11

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 11

CONCLUSION AND RECOMMENDATIONS

An analysis of data on irrigation potential created and utilized in selected states under study points to a combination of factors accounting for the gap. These are:

11.1 Variations in Reporting of Data

The first set of problems relate to variations in reporting of data on the gap. The data on gap comes from multiple agencies, each following a different methodology for estimating the gap. Thus, while it is clear that the gap exists, not so clear is the exact size of the gap. For example, the irrigation department, while estimating the ayacut, goes by water released; the revenue department goes by water cess collected; while the agriculture department goes by the cropped area under irrigation. Irrigation department data on the size of the gap suffers from the limitation that it does not take into consideration the pilferages which take place across canals and distributaries. The revenue department's data is hopelessly outdated. And, the agriculture department's practice of reporting the gap based on cropped area irrigated errs from the fact that the actual cropping pattern may vary from what was stipulated at the time of creating the potential.

From our discussions with the senior officials of the respective departments, developing a common methodology for estimating the gap did not appear to be an immediate possibility. Under the circumstances, two alternatives exist a) stick to data provided by any one department (say, irrigation department) and assuming that methodological errors are a constant or declining function of time, monitor the trends in the gap and, b) go in for remote sensing satellite services, as attempted in the state of Andhra Pradesh.

11.2 Problems at the time of Project Design

Here it is important that the irrigation department clearly spells out the criteria adopted while arriving at the irrigation potential created. In the absence of that it will be difficult to verify if the

irrigation potential utilized is in line with the irrigation potential created. The problems can stem from two sources:

For example, the starting point of assessment of water availability in any project is the average rainfall, estimated from past rainfall data of 30 years or more. Based on this average rainfall, dependable yield is arrived at. However, 'average' rainfall does not say anything about timing and distribution of rainfall. Typically, if the timing and distribution is erratic, despite a high average rainfall, inflow into reservoirs will be less, resulting in lower IPC.

Also, it is important to find out if, at the time of project preparation, requirements of water for drinking and industrial use were taken into consideration. If not, water diverted for such uses will result in a gap.

If the gap is due to lower availability of water compared to DPR, either because of erratic timing and distribution of rainfall or diversion of water for industrial or drinking use, it is not a gap in the sense of this study. A gap will be defined as a situation when the availability of water is as per DPR, but there is a deviation between IPC and IPU.

The way out of this is to lay down the criterion clearly and, only after satisfying that the criterion has been fully met, assess the utilization, against potential created. In some cases, if actual water availability, for similar reasons, is more than DPR, it will be interesting to find out if any capacity storage tanks are created to store excess water.

11.3 Reasons for the Gap - Technical Factors

Here we summarize our findings on the reasons for the gap between irrigation potential created and realized, despite actual water availability being equal to DPR. These stem from:

a. Non-availability of required infrastructure - non-maintenance of WCS/Distributaries e.g. growth of weeds, collapse of side slopes, damage to side and bed linings, reduced waterways, seepage and leakage of canal waters etc.

b. Regulatory problems, including non-availability of measuring device.

c. Frequent breaches & unauthorized pumping

d. Violation of cropping pattern. The entire command area for the purposes of crops grown, will have to be looked into from three aspects – namely, a) Initial reach (i.e. just downstream of water storage/ head) b) Middle reach and, c) Tail ends. The quantity of water reaching these zones vary on account of losses and friction encountered in the conveyance system. Generally farmers of initial reach and middle reach go for crops based on market signals and end up consuming more water. They do not follow the cropping pattern recommended by irrigation department. If crop pattern is not as per DPR, there will be considerable variation in consumption of water, thereby causing a gap. Rotation of crops in various seasons like Rabi, summer and perennial, must be as per DPR.

e. Differential water management effectiveness through farmers' federation of cooperative societies at various levels. Data should be collected on crop pattern adopted, season wise/ crop wise water requirements, supply of water from the department as against measurement of water done while regulating to the fields in command area. It is also necessary to ensure that upstream controls are provided such that water reaches the tail-enders thereby adopting proper water management and crop pattern for the optimum utilization of waters available.

11.4 Economic Factors

One important reason for the technical problems coming in the way of full utilization of potential cited above is lack of budgetary support for operation and maintenance (O&M) of irrigation projects. The annual budget releases for O & M of major projects are grossly inadequate. In some cases, in the name of economy, attempts have been made to prune down the lower level staff deployed in O & M of major projects. But this has resulted in forcing the administration to cough up more money after few years to repair the system & put it in order. Indirect loss, by means of less crop output, and others from not maintaining the system properly can also be sizeable.

11.5 Social & Political Reason

Social and political factors have also played an important role in the indifferent attitude of water users towards optimizing water use. Clearly, a spirit of cooperation between the adjoining villages, mandals & districts in prudent utilization of available water is yet to be inculcated. There are instances of disputes between the farmers as also between districts.

Minor disputes, which can be sorted out at village level are blown out of proportion, if the political leadership in the villages, involved in the dispute, belong to different political parties. Most of them are not interested in common good of the people; they are interested in making the dispute a stepping stone for their self promotion.

It is necessary to collect the data for at least 2 to 3 years and estimate the gap as suggested in Section I and II above. The study team was not able to obtain data in the prescribed format from the irrigation departments. The estimation of gap and the corresponding reasons for the gap have been carried out based on the rudimentary data made available by the departments as well as the information obtained through PRAs and primary data. It should be understood that the irrigation potential created cannot be treated as static. The potential created depends on the inflow of water, actual cropping pattern followed as well as the consumptive use of water for different crops.

Based on the scanty secondary data that was made available, primary data collected from the farmers, the PRAs carried out with the representatives of the water users' associations and officers of the departments concerned with irrigated agriculture, the following steps are suggested to minimize the gap between irrigation potential created and irrigation potential utilized.

11.6 Steps for minimizing the gap between irrigation potential created (IPC) and irrigation potential utilized (IPU)

The definition and quantification on the IPC and IPU has to refined and calculated as per the procedure given in Section 10.5

Based on the above process, the gap between IPC and IPU itself is to be recalculated. The methodology mentioned in the earlier sections enables clear identification of the reasons. These reasons are classified into 4 categories. These categories and remedial measures for minimizing the gap are presented below.

I. Low rainfall in the catchment area leading to lower inflows of water
II. Deviation of cropping pattern
III. Unauthorized usage of irrigation water for growing crops outside the command area (this category was not included in chapter 10, because this is outside the purview of the schedules)
IV. Maintenance and administrative problems

11.6.1 The remedial measures

The following remedial measures are suggested below to minimize the gap:

1. The information on the expected rainfall and the quantity of inflows has to be estimated well before the cropping season. These estimates will be less accurate for the Kharif season, but highly accurate for the Rabi season.
2. Taking into account, the expected inflow of water the irrigation department and agriculture department should prepare the best possible cropping pattern for the season in the command area in order to maximize the potential utilized. If necessary, optimization techniques such as linear programming need to be used.
3. Based on the above cropping pattern the expected schedule for water release at each pipe command level needs to be finalized and announced. This information should all the farmers in the command area.
4. The farmers in each pipe command area are to be encouraged to follow the above cropping pattern.
5. Any deviation from the cropping pattern will be penalized in the form of lower water supply and higher penal rates for water.
6. The support of the water users' associations and elected representatives of the local bodies have to be enrolled in the implementation of the above cropping pattern in each season.
7. The facilities provided by other departments such as agriculture department in terms of supply of high yielding variety seeds, concessional credit, agro processing facilities should be leveraged to make sure that the farmers follow the suggested cropping pattern.

8. The unauthorized utilization of the irrigation water outside the command area has to be controlled.
9. In case it is not possible to control this unauthorized use, the departments need to redefine the boundaries of the command area and recalculate the IPU taking this unauthorized use into account.
10. The above area so defined will also form part of the cropping pattern exercise given earlier.
11. It is found that the budgetary allocation for maintenance works is very low and inadequate. Consequently, the required maintenance is not being carried to the desired extent. There is an urgent need to revise the maintenance budgets upwards.
12. Separate circles/divisions have to be created exclusively for maintenance and these circles/divisions need to be delinked from construction activities.
13. There are a number of maintenance works pending over the past few years due to lack of budgetary support. There is an urgent need to create project specific schemes to clear the entire backlog with dedicated budgetary support.
14. Maintenance can be done only when the canals are closed, which usually falls in the months of April, May and June. Because of the budgetary practices followed, the release of funds to the department takes place only after May-June. This leaves very little time to take up maintenance works. Hence it is suggested that a non-lapsable fund needs to be created exclusively for maintenance activities.
15. It was found that the portion of the water rates retained with the water users' associations is insufficient for maintenance works. It was found that the water users associations do not collect the water rates due to a variety of reasons affecting the maintenance. Thus there is a need to augment the funds for maintenance activities with other resources

11.7 Summary

There are several lessons to be learnt from this study. First, while there is no question about the presence of a gap between irrigation potential created and utilized, trying to figure out the exact size of this gap and the reasons thereof are riddled with methodological and procedural errors. First, different organizations connected with irrigated agriculture follow different methods for estimating the gap. Second, the concerned departments either do not maintain or are unwilling to

part with the crucial data that is needed to address this issue, at the project level. Not only data limitations interstate water disputes have contributed to this.

Nevertheless, some common explanations for the gap have emerged from the study irrespective of the methodology used. These are a) non-cooperation of the farmers despite the setting up of Water Use Associations, though the impact has varied between states b) non-adherence to cropping pattern and, c) technical problems, particularly at the canal level.

A comprehensive analysis carried out by the Maharashtra State Irrigation Department identified the following reasons for the gap between irrigation potential created and utilized.

- Low water yield in the reservoirs
- Diversion of irrigation water to non-irrigation uses
- Tendency of farmers to grow cash crops which are highly water intensive like sugarcane, banana
- Low utilisation during kharif (Rainy) season
- Reduction in storage capacity due to silting
- Lapses in assessment of the irrigated area in the command
- Non accounting of irrigated area outside the command (influence area)
- Poor maintenance of the infrastructure due to financial constraints
- Non participation of beneficiaries in irrigation management

Clearly, every stake holder has a role to play in ensuring that the water resources of the country are harnessed and utilized properly for the maximum good of the people of the country. The long term sustainability of the economy, food security and stability of prices all depend upon this.

To the extent that the study has identified the main reasons for the gap, it is necessary to prioritize those so that action can be initiated in a more focused manner. There is no national answer to the problem. The solution has to evolve at a disaggregated level. There is a need to maintain proper data base at the project level, main canal and distributor levels to quantify and undertake remedial measures to minimize the gap.